MSc Dissertation

Location Services: Adding value to incident management ?

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Declaration of originality

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Manchester Metropolitan University or to any other institution for assessment for any other purpose.

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Abstract

The Dutch Directorate for Public Works and Water Management (RWS) as highway authority is committed to implementing Incident Management (IM+) measures on the national Dutch motorway network. The aim of these IM+ measures is to ensure the safe and rapid handling of incidents so that the traffic flow restrictions caused by an incident are lifted as quickly as possible. In practice, this means some technical measures and co-operation between the RWS and professional emergency services. For these cooperative partners the availability of reliable and up-to-date Spatial information plays an important role in handling incident calls. To make the required information accessible in the field a new Information technology that take your geographic location into consideration, called Location Services, is planned to become available for the RWS. But with all their duties are the Dutch Road inspectors of RWS willing to adopt this new technology?

This research project explores the acceptance and usage behavior factors of the Dutch Road inspectors of Location Services (LS) with Incident Management (IM+). By using the Technology Acceptance Model of Fred Davis (Davis, 1989) the understanding of their acceptance processes is improved, providing theoretical insight into the successful implementation and adoption of LS with IM+. The results of this research project show that the Dutch Road inspectors seem willing to adopt LS with IM+. The gained knowledge of the independent variables of the Dutch Road inspectors will enable the management of the RWS to evaluate proposed Location Services prior to the implementation and with that provide useful information about the likelihood of success of adoption.

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List of Acronyms

Abbreviation	Full Dutch Name	English translation
ANWB	Algemene Nederlandse Wielrijders Bond	Royal Dutch Automobile Association
BPS	Beschrijvende Plaatsaanduiding Systematiek	Descriptive Location system
CPA	Centrale Post Ambulance dienst	Central Ambulance Station
CTPI	Coördinatie Team Plaats Incident	Incident Site Coordination Team
DVM	Dynamisch Verkeers Management	Dynamic Traffic Management
DRIP	Dynamisch Route Informatie Paneel	Dynamic Route Information Panel
IM+	Incident Management	Incident Management
KLPD	Korps Landelijke Politie Diensten	National Police Force
LS	Locatiegebonden Informatiediensten	Location Services
PEU	Verwachte Gebruikersgemak	Perceived Ease of Use
PU	Verwachte Bruikbaarheid	Perceived Usefulness
RWS	Rijkswaterstaat	Ministry of Transport. Directorate General of Public Works and Water Management
TDI	Toeritdoseer-installatie	Controlled access to motorways, with traffic lights
UPP	Uniforme Primaire Processen	Uniform Primary Processes
VCNL	Verkeerscentrale Nederland	Ministry of Transport. Department for Traffic Management and Information
VC-NWN	Verkeerscentrale Noordwest Nederland	Ministry of Transport. Regional, Traffic Control Center North West of the Netherlands
VHD	Verzekeraarshulpdienst	Insurers Helpdesk

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INTRODUCTION

Because of the increasing traffic load on the Dutch motorways the Netherlands become more and more confronted with traffic congestions. The total amount of vehicles is not equally divided and especially the western part of the Netherlands suffers the consequences (Figure 1.1).

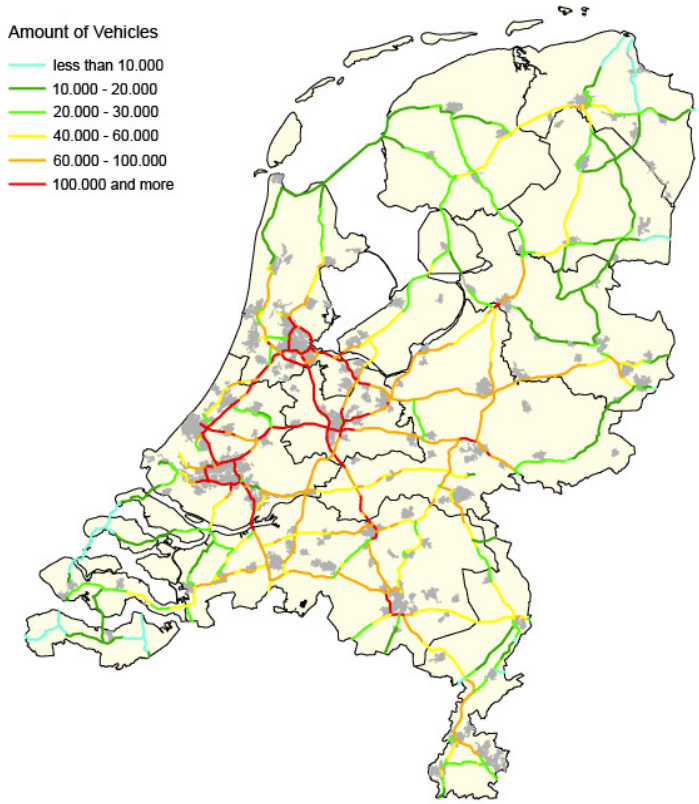


Figure 1.1: The average amount of traffic per road section per day in 2004 (Rijkswaterstaat AVV, 2004)

Traffic congestions can lead to more incidents due to closer vehicle spacing.

1.1 Incident Management

The consequences of incidents on the national Dutch motorways, such as crashes and vehicles shedding their loads are becoming more serious since the traffic load continues to grow. (Figure 1.2)

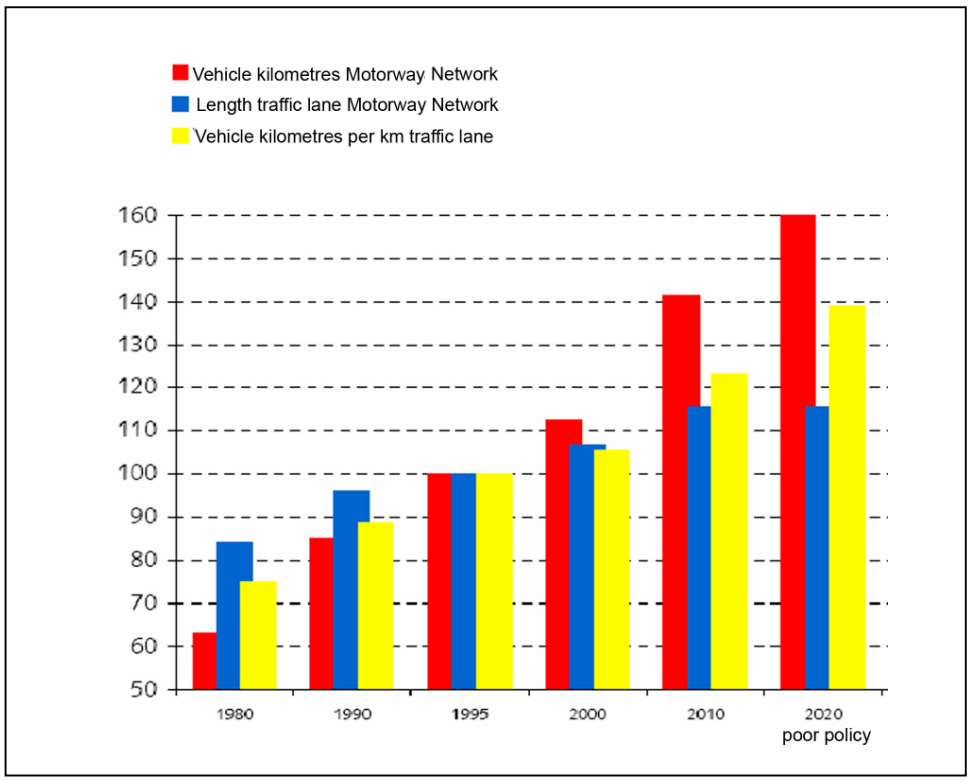


Figure 1.2: Development of vehicle kilometer per traffic lane Motorway (index 1995=100). (Ministerie van Verkeer en Waterstaat, 2003).

Some 13% of the traffic jams on the Dutch roads are the result of those incidents (Rijkswaterstaat, 2005). Traffic congestion is a major social and economical problem. For that reason the Dutch Directorate for Public Works and Water Management (RWS) as highway authority is committed to implementing Incident Management (IM+) measures on the national Dutch motorway network. The aim of these IM+ measures is to ensure the safe and rapid handling of incidents so that the traffic flow restrictions caused by an incident are lifted as quickly as possible. In practice, this means some technical measures and co-operation between the RWS and professional emergency services (National Police Force (KLPD), the Regional Police force, the Insurers Helpdesk, the vehicle recovery companies, the Regional Fire Brigade, the Central Ambulance Station (CPA) and the Royal Dutch Automobile Association (ANWB)). (Rijkswaterstaat, 2005).

The RWS, the Police force, the Regional Fire Brigade and the Central Ambulance Station (CPA) cooperate as the core of the Coordination Team (CTPI). The commander of the Central Fire Brigade operates as the chief in command, but the responsibilities lies with all the cooperative actors together. Each cooperative actor manages his own staff (Jorna, 2007), has his own way of communicating with each other, mostly by direct mobile phone (Rijkswaterstaat, 2005) and has its own way of defining the location of the incident. (BPS) (Ministerie van Verkeer en Waterstaat, 2002.).

During the IM+ processes the activities of RWS and the emergency services are dependent on each other and it is of great importance that before and during an incident all the parties involved stay well informed. The availability of reliable and up-to-date Spatial information plays an important role in handling incident calls (e.g. traffic diversion, nearest hospital, routing vehicle recovery companies etc.)

A lot of activities are involved with IM+ and the communication is a major issue. The quality of the communication for a great deal determines the outcome of the decision making process and the possibility of supporting the common operational picture.

In April 2007 Prof Immers stated that the following bottlenecks in Incident Management exist: (Immers, 2007)

- Insufficient communication between the different actors;
- Usage of different spatial datasets and spatial data versions between the actors involved;
- Lack of information about the 'information' (meta-data);
- Difficulties in exchanging up-to-date information
- Using a descriptive method of defining the location of incident instead of accurate GPS location.

1.2 Location Services

Location Services (LS) or Location Based Services (LBS) are applications that take your geographic location into consideration using a mobile device with the possibility to determine its location (Devices using the Global Positioning System (GPS), Mobile phone etc.) . The user of such a device has the opportunity of deriving information dependent of his location (Buehler, 2002). (Pull Information Service)

LS can also provide location based information without interaction of their user (Push / Trigger Service).

With the technological innovation of LS it is possible to deal more efficiently with the means of communication and to develop and implement new information services. (Beinat et al, 2005). With the use of LS it is not necessary for their user to have all the information on his portable device, because the wireless connection gives the possibility to derive the information from a data server, depending on the location of the user and the mobile device.

1.3 Technology Acceptance

Significant progress has been made in explaining and predicting users acceptance of information technology (Venkatesh and Davis, 2000)
The Technology Acceptance Model (TAM) presented by Davis in 1989 contains two variables:

- Perceived usefulness and
- Perceived ease of use

Perceived usefulness is defined as the extent to which a person believes that using the system will enhance his job performance.
Perceived ease of use is defined as the extent to which a person believes that using the system will be free of effort.
The TAM theorizes that the intention to use LS is influenced by the effect of external variables (hardware, software, training etc.) and their related usefulness and easy of use. (Davis, 1989)
In January 2005 a business case was drawn up by the SPINlab, Amsterdam, which proved that IM+ could benefit significantly in efficiency when implementing LS (Beinat et al, 2005). (see paragraph 4.4 Table 4.4). Despite of the impressive advances in efficiency and communication capabilities, the problem of low usage or troublesome adoption remains.

This research project aims to find elements that affect users behavior and acceptance of the implementation of LS with Incident Management.

1.4 Dissertation Structure

This overview clarifies the structure of this MSc dissertation and the outlines of the chapters that are included.

Chapter 1 provides basic information of the main pieces of this research project. Furthermore the research aim and objectives are part of this introduction chapter.
Chapter 2 covers the literature review and shows more in depth information of IM+ (S)[1], Location Services (S) and Technology Acceptance (P)[2]
Chapter 3 clarifies the conceptual model of this research project and the shadowing process. The shadowing process is used to retrieve the required information for designing the questionnaire and to investigate if the theoretical Uniform Primary Processes (UPP) are valid in practice. This chapter also covers the designed questionnaire, its response, the data used and the methods of data analysis.
Chapter 4 shows the results of the investigation of the UPP with LS and with that shows the possible added value of using LS with IM+. This chapter also covers the results of the statistic analysis of the hypotheses.
Chapter 5 discusses if the results matches the original aim and objectives stated in chapter 1.
In chapter 6 the conclusions of this research project are made. This chapter also contains a reflection paragraph.

[1] S=Secondary Literature, P=Primary Literature
[2] TAM, Questionnaires (Theoretical), Shadowing

In figure 1.3 a graphical approach is presented to show the dissertation structure of this research project.

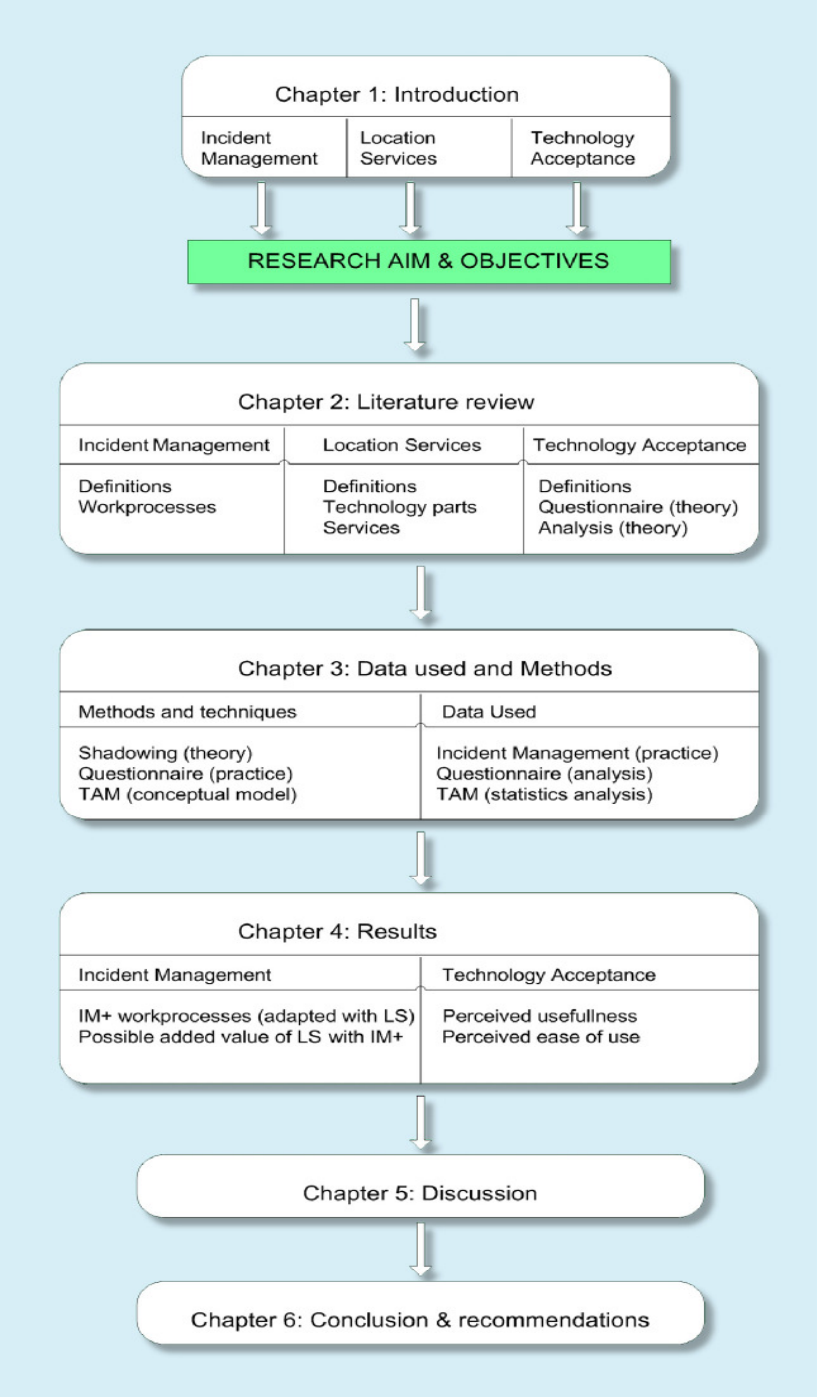


Figure 1.3: Dissertation Structure

1.5 Aim and Objectives

As mentioned in chapter 1.1 each IM+ actor and related emergency service has his own way of communicating with each other, mostly by direct mobile phone and has its own way of defining the location of the incident. The significance of this research project lies within the need of sharing the same spatial information. Because of the diversity of the procedures of all actors involved this research project aims on the procedures of the highway authority (RWS) and the staff involved in performing IM+ measurements. (Figure 1.4)

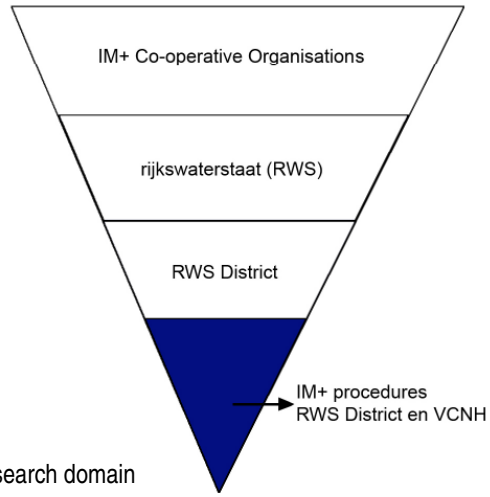


Figure 1.4: Research domain

1.5.1 Research Aim

The aim of this research project is to explore and to model the acceptance and usage behavior factors of the Dutch Road inspectors of Location Services with Incident Management.

The contribution of this research project is a series of recommendations when changing the IM+ processes and acceptance elements, focusing on implementation and technology acceptance of Location Services, by analyzing the current work-processes of IM+ of RWS and to make an inventory of existing Location Services.
The contribution of this research project is:
Primary:

- An overview which shows the possible added value using LS with IM+
- Recommendations concerning elements, that affect the user-acceptance when implementing LS with IM+

Secondary:

- A report of the analysis of the RWS IM+ work procedures
- An overview of Location Services (LS)
- A functional design for a Proof-Of-Concept of LS with IM+

1.5.2 Research Objectives

Main question:

"What factors do influence the adoption of LS with IM+ by the Dutch highway authority ?"

Sub questions:

1. What is Incident Management (IM+)?
    - Relevant definitions, conceptions, policy aims
    - How are the work procedures of the Road inspectors in practice?
    - What information is required?

2. What are Location Services (LS)?
    - Relevant definitions, conceptions, classification of services and technology parts

3. What possibilities exist using LS regarding to IM+?
    - How can I make the LS contribution measurable?
    - What is the contribution of LS regarding to IM+?

4. How can the user acceptance of LS be measured?
    - Which adoption theories exist?
    - Which theoretical elements can be identified?
    - How can these theoretical elements be made operational?

5. What subdivisions of the Dutch Road inspectors can be identified according to the user acceptance of LS?
    - Which statistical methods are commonly used in data processing?
    - How do the factors of user acceptance relate?

Chapter 2

LITERATURE REVIEW

2.1 Incident Management (IM+)

A lot has been written by the Dutch Highway authority RWS concerning IM+ and its procedures (Rijkswaterstaat, 2005; Leopold et.al, 2005; Rijkswaterstaat VCNL, 2005a; Rijkswaterstaat, 1999). According to Rijkswaterstaat Incident Management can be defined as:

"*Incident Management is the entirety of measures that are intended to clear the road for traffic as quickly as possible after an incident has happened."*

(Rijkswaterstaat VCNL ,2005b. pg.5)

These measures concern matters like: (Rijkswaterstaat VCNL, 2008)

1. improvement of the organization, the communication and the cooperation with different IM+ partners
2. Technical and process measures to reduce the time of completion.

Also a project to realize uniform primary processes (UPP) is currently underway at RWS, the aim being to have districts operate with greater uniformity and efficiency. (Rijkswaterstaat, 2006). Over the last year RWS has defined most of the work-processes using process models. (UPP).

Appendix 1 shows the workflow of the work processes of Incident Management within the organization of RWS.

When executing this process the sequential priorities are: (Rijkswaterstaat VCNL, 2005a)

1. the emergency worker's own safety
2. traffic safety
3. adequate treatment to casualties
4. the flow of traffic
5. damage reduction (environmental, cargo, vehicle, social)

2.2 Location Services

Whereas the conventional applications mostly assume stationary or fixed users, more and more emphasis is placed on mobility, the need for people to stay connected while moving around. One application domain, which is expected to greatly benefit from mobile commerce are location-based services (LBS).
Location Based Services (LBS) or Location Services (LS) are applications that perform based on a geographic region such as a city, country, street address or mobile device location. (Deitel, 2008)
From now on in this thesis the term LS will be used except when using references.
While the term LS generally refers to services accessed on mobile devices using the Global Positioning System (GPS), it can also be used to describe web applications that take your location into account.

Virrantaus (2001) defined Location Based Services as:

"LBS are information services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the mobile device".
The OpenGeospatial Consortium (OGC, 2005) had a similar definition for Location based Services:

"A wireless-IP service that uses geographic information to serve a mobile user. Any application service that exploits the position of a mobile terminal."

According to Narushige Shiode et al (2002) the relatively young information technology LBS is developed from New Information and Communication Technologies (NICTS) such as the mobile telecommunication system and handheld devices, from Internet and from Geographic Information Systems (GIS) with spatial databases. (Figure 2.1)

With IM+ LS (or LBS) can be interpreted in two ways:

1. Services that supply the Road inspector with the required Information, dependant of his or her location.
2. Services that supply the Traffic Control Centre with information of the location and actions of the Road inspectors.

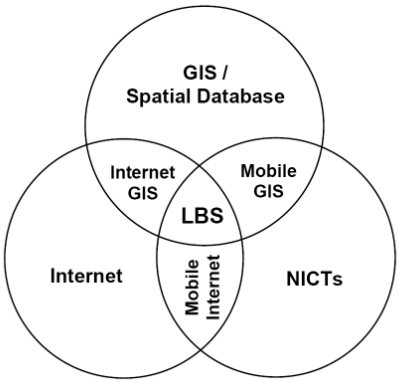


Figure 2.1: Convergence of technologies creating LBS (source: Brimicombe, 2002).

LS hold a package of information services that can be used to give fieldworkers like Road inspectors the opportunity to access data and geoinformation real-time. LS give the possibility of a two-way communication and interaction. Therefore the Road inspector 'tells' the service provider his actual context like the kind of information he needs, his preferences and his position. This helps the provider of such location services to deliver information tailored to the Road inspectors needs. (Steiniger et al, 1999)

Figure 2.2 shows four segments of working 'mobile' with spatial information (Beinat et al., 2005):

- *'Digital paper'* refers to local administration on the mobile device (e.g. laptop or tablet PC), like working with digitalized forms where it is not necessary to have a connection to a corporate database real-time and where location is not important
- *'Mobile forms'* refers to working in the field where the user has the opportunity to check and update the information real-rime (upload and download possibilities), without the importance of the location.
- With '*Mobile GIS'* the user has mobile GIS functionality available to work in the field with spatial data (e.g. maps, location stamps data). With 'Mobile GIS' the user is not connected to a corporate database, but is able to determine his location with GPS.
- *'Real-Time location information'* mostly indicates LS. It contains both *`Mobile forms'* and *`Mobile GIS'.* With this segment the user is able to determine his location, filter information based on the location, to access information real-time and has the possibility of sharing information with other partners.

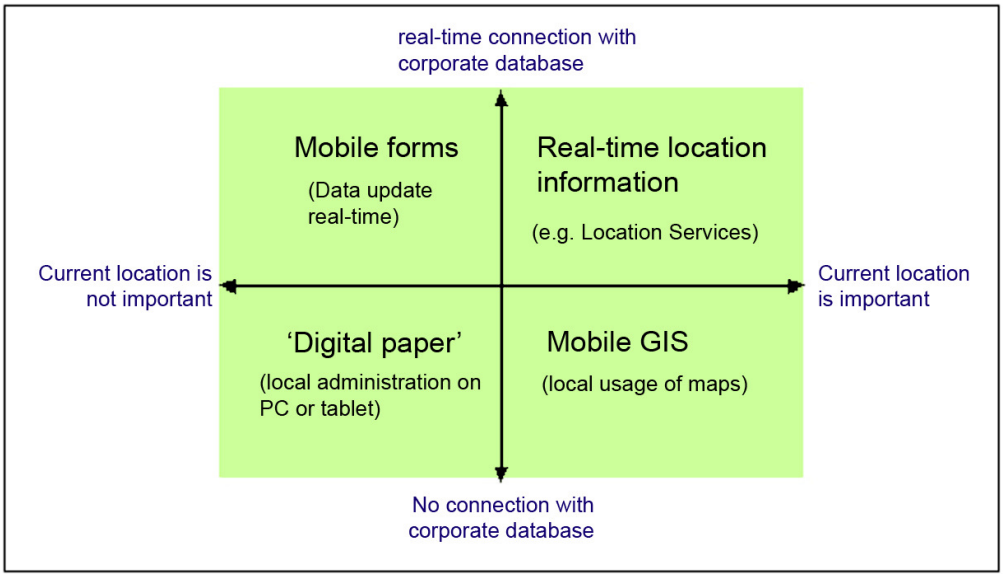


Figure 2.2: Working 'Mobile' (Beinat et al, 2005)

When studying the literature concerning LS it is striking that, because of the context dependency, different definitions and terminology exist (Grothe and Steenbruggen, 2002; Rainio, 2001; Spinney, 2002).
Table 2.1 shows examples of other terminology of LS.

Table 2.1: Examples of terminology of LS

Terminology of Location Services
Location Based Services
Mobile Location Commerce
Location Based Commerce
Mobile Location Services
Wireless Location Services
Personal Navigation Services
Position Dependent Services
Mobile Positioning Services

However, all the different definitions and terminology are unambiguous of the fact that the location of the device (or of its user) is the most important factor when offering Mobile Location Services (Steenbruggen, 2004)

With the current tendency of working 'mobile', the new mobile telecommunication technology and location services enable organizations like RWS to supply their staff, working 'in the field', with information real-time.

With the Dutch highway authority (RWS) a couple of thousand staff members on a regular basis are working in the field, using especially spatial related information. (e.g. routing a vehicle recovery company to the location of the incident) or LS make it possible for these fieldworkers to have access to the spatial data real-time, to locate the users and to integrate digital spatial information in the work processes of the fieldworkers and with that enhance the efficiency of the mobile work processes and benefit the coordination.
To be able to offer the online geo-information services it is necessary for LS to know the location of the user. The location is determined based on the location technology of the device and communication infrastructure, possible in combination with GPS-technology (Steenbruggen and Grothe, 2003)

The main collaborating components of LS are: (Figure 2.3)

- Location technology
- Communication Network
- Geo-Information Services (Service and Content Provider)
- Mobile devices

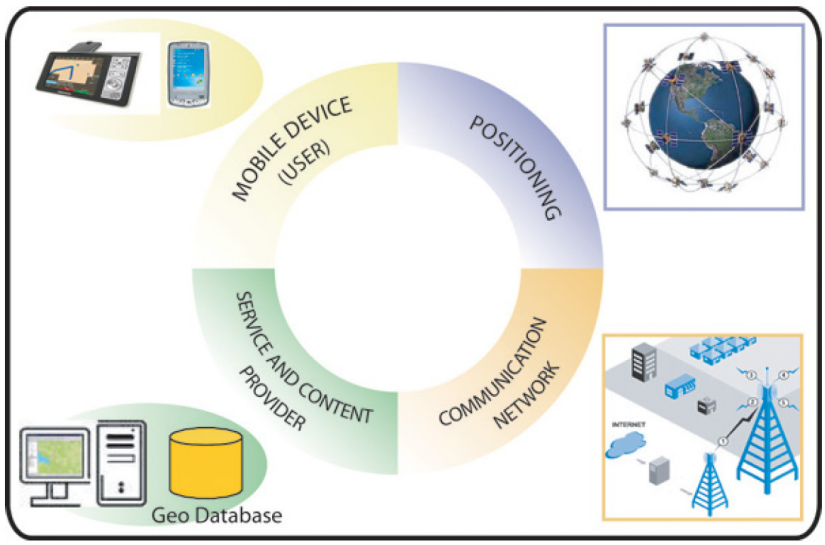


Figure 2.3: The basic components of an LBS: User, Communication Network, Positioning, Service Provider and Content Provider. (Steiniger et al, 1999)

2.2.1 Location Technology

A common technology for location determination is the Global Navigation Satellite System (GNSS). Over the last years the Global Positioning System (GPS) has proved to be the most applied location system (Steenbruggen, 2004)

GPS is a satellite based navigation system of 24 satellites that enables users to know their position and time on Earth. Each satellite passes around the earth twice in a 24-hour period at an altitude of about 12,500 miles. Radio signals from these satellites can be used to determine accurate Geo-referenced position information. Although three GNSS systems are currently in existence, NAVSTAR, GALILEO and GLONASS, the term 'GPS' is commonly used to refer to NAVSTAR, the global positioning system developed by the American Military.

GALILEO is a civic developed GPS system, an initiative launched by the European Union and the European Space Agency, and was scheduled to become available to the public in 2008, but because of lack off money is postponed until 2013. GALILEO is based on a constellation of 30 satellites and ground stations (European Commission, 2007).

The Russian Global Navigational Satellite System (GLONASS) has been operational since early 1996, but suffers limited availability due to lack of maintenance. Work is underway to modernize the system. (Federal Radio navigation Plan, 1994; Andrews Space & Technology, 2004)

Each GNSS system consists of three sub-systems: a space segment, a control segment and a user segment.

The space segment is a constellation of dedicated satellites in orbital planes around Earth. Each satellite continuously transmits ephemeris data, uniquely identifying the satellite plus date and time of broadcast, and almanac data, containing the accurate position of the satellite. The configuration of the orbital planes ensures that anywhere in the world enough GNSS signals can be received to deduct time and position at the reception location. The control segment consists of ground stations located worldwide, providing the satellites with accurate ephemeris and clock data. The user segment consists of GNSS receivers. GNSS receivers require at least four satellite signals to compute the position and time of the receiver by using the triangulation method. With triangulation the position is determined by measuring the distance from other objects with known locations. The signals from a satellite are used to determine the distance from that satellite. If you use distance information from at least three satellites, your location is determined at one or two points.

Though one of the points can usually be eliminated as an unreasonable location, a fourth satellite signal will give confidence in which point is valid. Though only four satellite signals are required to get a valid position, some receivers are equipped to receive as many as 12 satellite signals simultaneously. The extra satellites are used to increase accuracy (Stombaugh and Clement, 1999).

Besides device related location techniques (e.g. GPS) the interest in Network location technology is growing rapidly. (Figure 2.4)

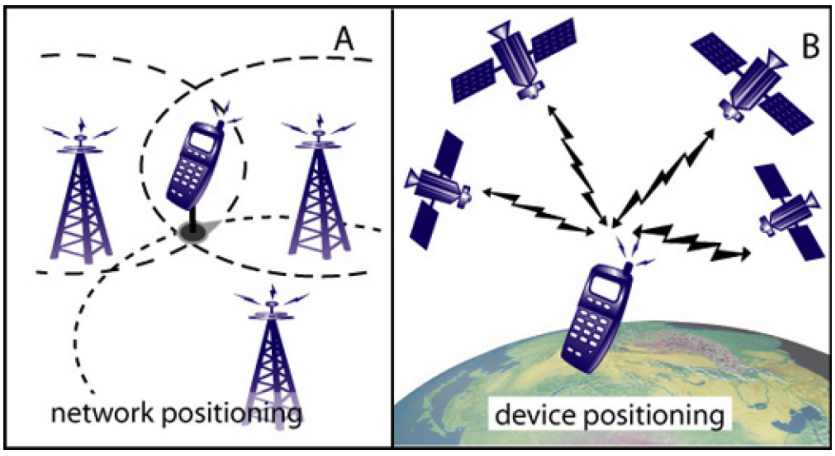


Figure 2.4: Types of mobile positioning (source: Steiniger et al, 1999)

Location Services (LS) need the location to offer the required information.
To clarify the accuracy and availability characteristics Figure 2.5 and table 2.2 give an overview of the relations between several location techniques. As shown the accuracy of GPS is sufficient enough for the usage of LS with IM+.

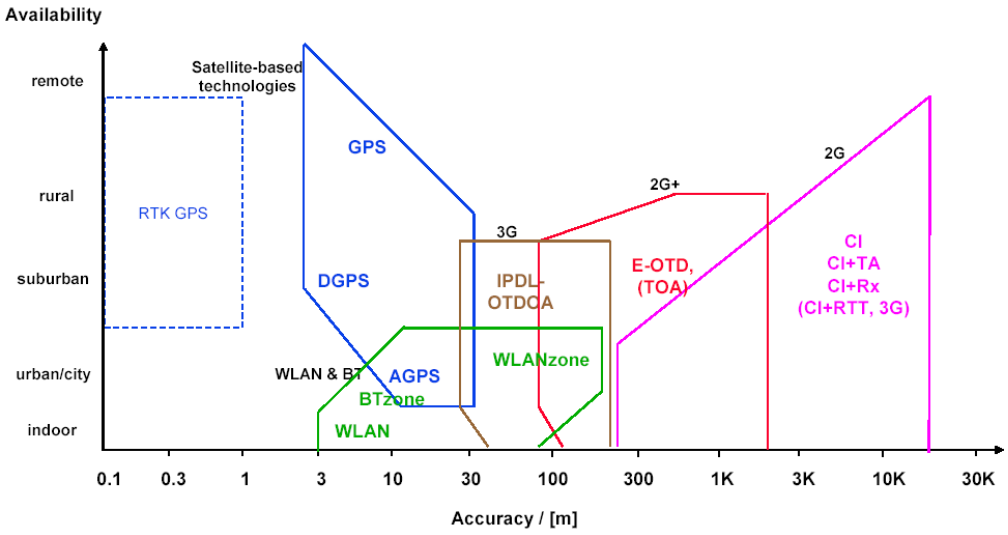


Figure 2.5: Overview of most important location techniques (Niiranen S., 2001)

Table 2.2: Overview of GSM location technology (Helios Technology Ltd, 2002)

Techno logy	Rural	Rural extreme	sub-urban	sub-urban extreme	urban	urban extreme	indoor user
CI	1 - 35 km	1 - 100 km	1 - 10 km	1 - 10 km	50 m - 1 km	50 m - 1 km	no change unless there is a pico-cell
CI+TA	1 - 35 km	1 - 100 km	1 - 10 km	1 - 10 km	50 m - 1 km	50 m - 1 km	no change unless there is a pico-cell
E-OTD	50 - 150 m	50 - 150 m or unavailable if not 3 BTS	50 - 150 m	100 - 250 m	50 - 150 m	100 - 300m	slight degradation but penetrates well indoors
A-GPS	10 m	10 m	20 m	50 - 328,08 ft	30 - 100 m	50 - 100 m if available	in-building coverage by windows but not deep inside
rural: sparsely inhabited areas, field and forests; **suburban:** populated areas, residential houses, villages; **urban:** densely populated area, multi-story buildings, offices and city centers;							

Table 2.3 shows the different location techniques with their location determination

Table 2.3: Location Technology (Steenbruggen, 2004)

Technology		location determination
GPS	Global Positioning System	triangulation of satellite signals
DGPS	Differential GPS	GPS with the use of a network of fixed ground based reference stations to broadcast the difference between the positions indicated by the satellite systems and the known fixed positions
RTK GPS	Real Time Kinematics GPS	GPS with own base FM-station(s)
AGPS	Assisted GPS	GPS validated with GSM correction signals
CI	Cell ID	(Cell of origin) Coordinates of GSM-pole of the used cell
CI+TA	Cell ID + Timing Advance	Cell-ID validated with measured signal time of GSM pole
CI+Rx	Cell ID + Reference signal power budget	Cell-ID validated with measured received signal strength
CI+RTT	Cell ID + Round Trip Time	Cell-ID validated with time difference measurements
E-OTD	Enhanced Observed Time Difference	Timing Advance of a minimum of three GSM-poles
IPDL-OTDOA	Observed Time Difference of Arrival (with Idol Period Downlink Support)	algorithms for positioning a mobile phone using 3GPP-FDD mode signals

2.2.2 Communication Network

As mentioned in paragraph 2.2.1 one of the functions of Communication Network is location. Another function is transport of information. When talking about the collaborating components of Location Services this latter function is meant by *Communication Network*, because for the component *Positioning* other location techniques are more obvious for the use with LS.

2.2.3 Geo-Information Services

A big variety of LS exists. When reviewing literature different classifications can be identified. To give a structured overview of LS for example these Services can be classified:

- by functionality (The Strategis Group, 2000)
- by location accuracy (Grothe and Steenbruggen, 2002)
- by end-user (Steenbruggen, 2004)

Table 2.4 till table 2.6 show these classifications with examples and applications of Location Services.

Table 2.4: Location Services Categorized by FUNCTIONALITY (The Strategis Group, 2000)

Trigger services	Information service	Tracking services	Assistance services
Location-sensitive	Mobile yellow pages	Commercial fleet	Emergency
Billing	Traffic reports	Management	Notification
Automated	Weather notification	Find-a-friend	Roadside assistance
Advertisement	Navigation information	Buddy services	Health and medical related ID
Special	Wireless internet	Asset tracking	
Announcement	services	Public safety	Efficient enhancement for business applications
Mobile commerce	Tourist services	Dispatch	
Security	Dating and games	Agency personal	
Enhanced call routing	Logistics management	Safety	
Tolls and ticketing			

Table 2.5: Location Services Categorized by LOCATION ACCURACY (Grothe and Steenbruggen, 2002)

Location accuracy	Application
Location independent	Stock prices, news, bank transaction, e-mail, agenda
Regional (>100 km)	Weather reports, regional news, generic traffic conditions
District (up to 20 km)	Local news, traffic reports
Up to 1 km	Vehicle asset management, fleet management, congestion avoidance
500 – 1000 m	Emergency services, manpower planning, information services, point of interest search
100 – 200 m	Urban SOS, localize advertisement, network maintenance, asset tracking, nearest point of interest, people location, wireless ICQ
10 – 100 m	Asset location, stolen vehicle, turn-by-turn directions
Indoor one-to-one identification(< 1 m)	Object identification, shop information

Table 2.6: Location Services (Pull) Categorized by END-USER (Steenbruggen, 2004)

Information service	Consumer	Business	Government
Positions	Where am I? (map, address, place)	Contact nearest field service personnel	Location sensitive reporting
Events (Push)	Medical alert!	Traffic alert!	Accident alert!
Distributions	House hunting in low density area	High growth trend?	Growth patterns?
Assets	Where is my car?	Where are my dispatches repair trucks?	Where are the snowplows?
Services Points	Where are the sales?	Targeted advertising	New zoning
Routes	Fastest route (given traffic situation)	Taxi dispatch	Emergency dispatch
Context / overview	Nearest visible landmark?	Best supplier within next two hours	Collaborative economic planning
Directories	Where can I buy? (product services)	Low cost distribution services	Public revenues
Transactions	Lowest shipping rates?	Low cost distribution services?	Tax revenues
Sites	Places to visit	Optimum cell tower locations	New schools?

In general one can distinguish two different kinds of LS considering if information is delivered on user interaction or not: Pull Services and Push Services (Steiniger et al, 1999). But also Tracking and Tracing is regarded as a common used functionality of LS.

2.2.3.1 Pull services

Pull services deliver information directly requested from the user, like ordering an ambulance or vehicle recovery company by just pressing a button on the device, or information services, like the search for a close pizza restaurant (Figure 2.6). The urge of wanting a pizza can be made clear by using a voice interface. Through voice recognition the question is directed to the geographical database with pizza restaurants. When the location of the 'caller' is clear a couple of nearest pizza restaurants are shown to this caller on his mobile device. Not only the location of the restaurant but also information about the menu can be made available. With the help of an in car navigation system the driver can be routed to this restaurant. (OGC, 1999)

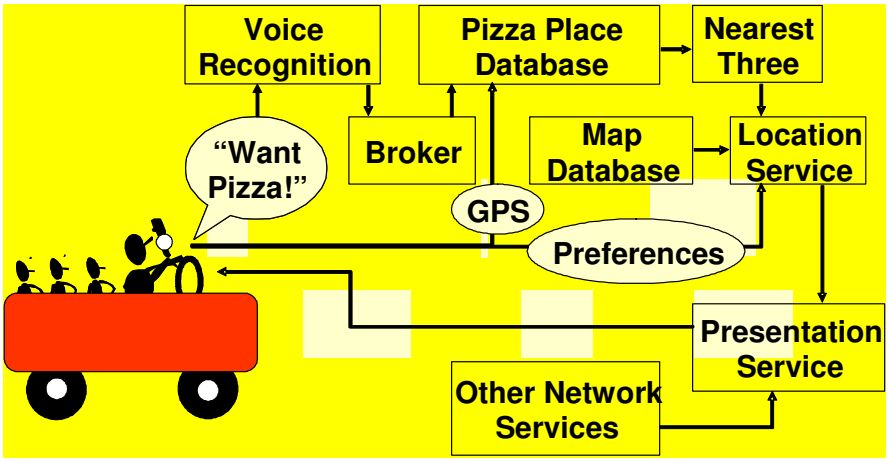


Figure 2.6: Pizzastory (OGC, 1999)

2.2.3.2 Push services

Push services deliver information which are either not or indirectly requested from the user. Such push services are activated by an event, which could be triggered if a specific area is entered or warning messages are given if traffic conditions change (Steiniger et al, 1999.)

2.2.3.3 Tracking and tracing

Tracking & Tracing services provide insight into the location of the vehicles or mobile devices of the Road inspector at a particular moment. (Steenbruggen and Mobarakeh, 2005), These services create a set of historical spatial data by way of recording the location of the mobile device and with that increase the traceability of the Road inspectors.

Figure 2.7 shows a small piece of the GPS tracking recorded on the first day of the shadowing process.

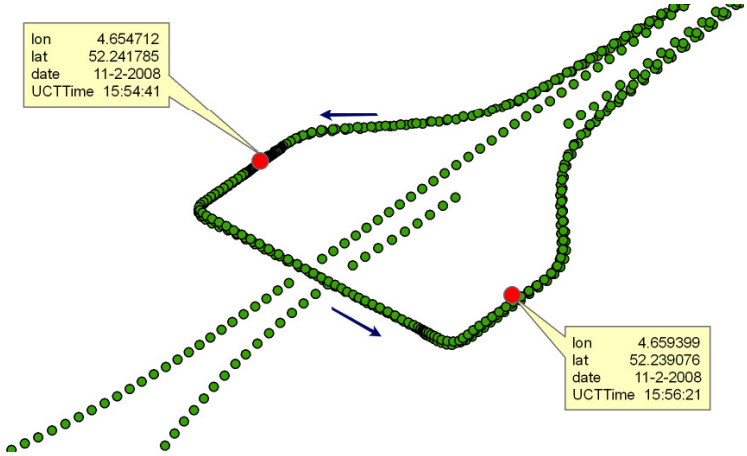


Figure 2.7: GPS tracking

2.2.4 Mobile devices

Besides the growing amount of location services the development and the availability of mobile devices are of crucial importance for the adoption of LS.

Not only the information made available with LS but also the attractiveness of well designed mobile devices can make the introduction of a new technology like LS successful. Some of the aspects of a mobile device that concerns their users are:

Table 2.7: Aspects of Mobile devices

Processor capacity
Memory technology
Attractiveness (design)
Weight / Size
Easy to use (user interface / human interaction)
Costs
(outdoor-) readability
In-car built-in possibilities

Because the total amount of the Road inspectors of the Dutch highway authority uses a great variety of official vehicles this latter two aspects could become the most important. Also besides IM+ the Road inspectors have other duties like surveying and measuring the traffic signs and the crash barriers. For this the device must have the ability of taking it out of the vehicle.

Figure 2.8: Measuring the location of traffic signs and administration.

This makes the choice of mobile device even harder. Figure 2.9 shows some examples of mobile devices.

Figure 2.9: Different mobile devices

2.2.5 Examples of required Information for IM+

Incident Management depends on accurate, relevant, on-time geo-information that various organizations systematically create and maintain.

When designing Information Services for IM+ for the required information the next aspects have to be taken into account:

- Availability
- Accessibility
- Affordability
- Timeliness
- Reliability

In 2005 a couple of workshops *"LBS-24-7"* were organized, where all the IM+ partners were participating. The outcome of these workshops pointed out that the following data address the criteria and are commonly used or desired. (Strien van et al, 2005)

Table 2.8: Examples of IM+ required Information. (S = Static Information, D= Dynamic information)

Information	Explanation	type
Nationaal Wegenbestand	Geographical information of the Dutch Highways	S
TOP10vector	Detailed topographic (vector) information of the Netherlands. Scale 1:10.000	S
TOP25raster	Detailed topographic (Grid) information of the Netherlands. Scale 1:25.000	S
CAN	Address coordinates of the Netherlands	S
Luchtfoto's	Full Colour Air View pictures (geo-referenced)	S
GBKN	High detailed topographic information of the Netherlands. Scale 1:1000 (urban) till scale 1:2000 (rural)	S
Cyclomedia	Panoramic 360^0 pictures (geo-referenced)	S
Usage: Reference and understanding of the geographical situation		
Location of person	Desired information	D
Traffic congestions	Desired information	D
Actual information of the incident	Desired information	D
Satellite pictures	More up-to-date Air View pictures	S/D (on demand)
Usage: Operational support		

2.3 Technology Acceptance Model

In the previous chapters, the elements IM+ and LS were highlighted to support “WHAT” and “ WHY” the research of user acceptance needs to be executed. This chapter deals with “HOW”.

Implementation of an innovative information technology, like LS only makes sense if the new system improves the current situation and if the Road inspectors are willing to use the new way of handling information. For this purpose the requirements and acceptance of the Road inspectors have to be identified precisely.
This chapter addresses Technology Acceptance Model (TAM) as a possible answer.

2.3.1 The Theory of Reasoned Action (TRA)

The Technology Acceptance Model (Davis, 1985) is based on the Theory of Reasoned Action (Figure 2.10), developed by Martin Fishbein and Icek Ajzen (1975, 1980), which stated that people consider their actions before they decide to perform or not perform a certain behaviour.
Intention is a major construct of this theory. The Theory of Reasoned Action is based on two hypotheses, that intention positively affects usage, and that attitude positively affects intention. On the basis of a person’s attitude and subjective norm an intention is formed that determines the actual use. (Ajzen and Fishbein, 1980). According to the TRA the attitude is defined as the individual’s negative or positive feelings performing a specific behaviour. Subjective Norm is defined as the perception of the individual that most people who are important to him think he should (or should not) perform that behaviour.

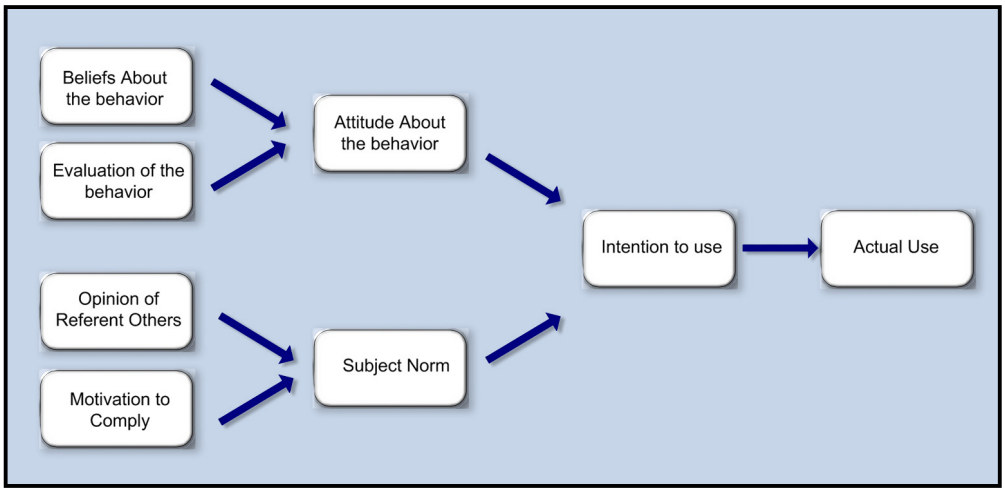


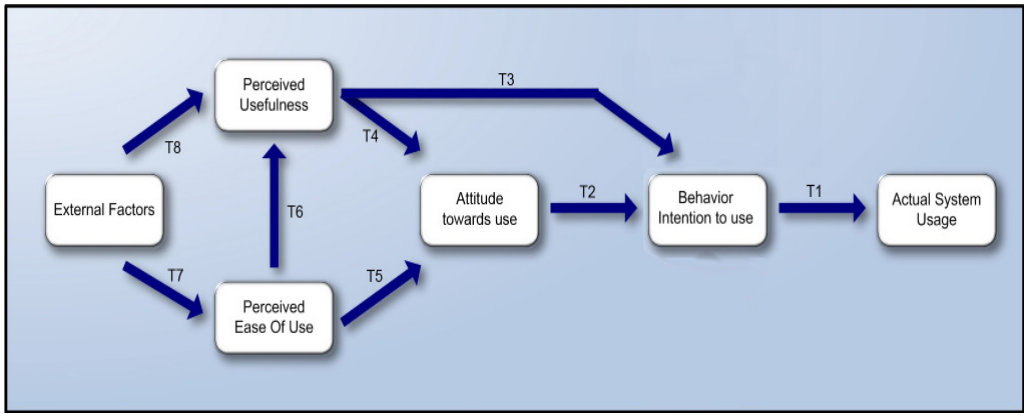
Figure 2.10: Theory of Reasoned Action (Ajzen and Fishbein, 1980)

2.3.2 Technology Acceptance Model (TAM)

TAM is one of the most influential extensions of the TRA, designed by Fred Davis (Davis, 1989) to measure the factors that explain the acceptance and usage of information technology. This designed model replaces many of TRA's attitude measures with, '*Perceived usefulness'* and '*Perceived ease of use'*

Perceived usefulness is defined as the extent to which a person believes that using the system will enhance his job performance (Davis, 1989).
Perceived ease of use is defined as the extent to which a person believes that using the system will be free of effort (Davis, 1989). This is an important construct, because an individual can still reject the proposed system if he believes that the effort to use it is bigger than its performance benefits, even when this individual considers a technology to be useful.

Figure 2.11 shows the theory of reasoned action combined with the technology acceptance model. The arrows represent the relations of the model. The relations T1 and T2 are based on the TRA, while T3 till T8 are TAM specific.



T1: intention to use determines actual system usage
T2: attitude towards use determines intention to use
T3: perceived usefulness affects intention to use
T4: perceived usefulness influences attitude towards use
T5: perceived ease of use affects attitude towards use
T6: perceived ease of use affects perceived usefulness
T7 and T8: external factors (dependent the field of study) relate to perceived usefulness and ease of use

Figure 2.11: Technology Acceptance Model (Davis, 1989)

TAM is based on a rational evaluation, where the behavioral intentions are the outcome of the rational assessment of the presented software, and the outcome determines the behavioral intention to use it (Davis, 1989).

Chapter 3

METHODS AND DATA

Introduction

When implementing an innovative technique like LS within the work processes of Incident Management the acceptance and usage behavior factors of the Dutch Road inspectors needed to be explored.

To be able to give the right answers to the questions stated in paragraph 1.5.2 to meet the aim of this research and to gather the required information the next methods are used:

Table 3.1: Methods of data and information collection

Sub question	Method
"What is Incident Management (IM+)?" *(theoretical and practical)*	Literature study, desk research, Interviews and Shadowing
"What are Location Services (LS) and what possibilities exist using LS regarding to IM+?"	Literature study, Internet research and desk research
"How can the user acceptance of LS be measured?" "What subdivisions of the Dutch Road inspectors can be identified according to the user acceptance of LS?"	Literature study, Internet research and Quantitative method (Questionnaires)

Analysis is performed using the following techniques:

Table 3.2: Methods of data analysis

Sub question	Method
1	Process analysis
2, 3	Literature study and desk research
4, 5	Technology Acceptance Model (TAM) , statistics (Frequencies, correlations and index of diversity ; SPSS)

3.1 Methods and techniques

To be able to determine the usability of LS within the work processes of IM+ of the Dutch Road inspectors and with that be a possible added value first clearness of these work processes is needed. Also the theoretical workflows of these work processes must meet the practice. For that reason not only desk research and interviews are carried out but also through shadowing the practice is compared with the theoretical UPP.
The added value of LS can only be established in practice when the end-user is willing to adopt the new adapted way of work. To be able to define the recommendations for the adoption of LS with IM+ the end-users requirements and intention to use need to be investigated. This investigation is performed using the Technology Acceptance Model of Davis in combination with a quantitative questionnaire approach. (Figure 3.1)

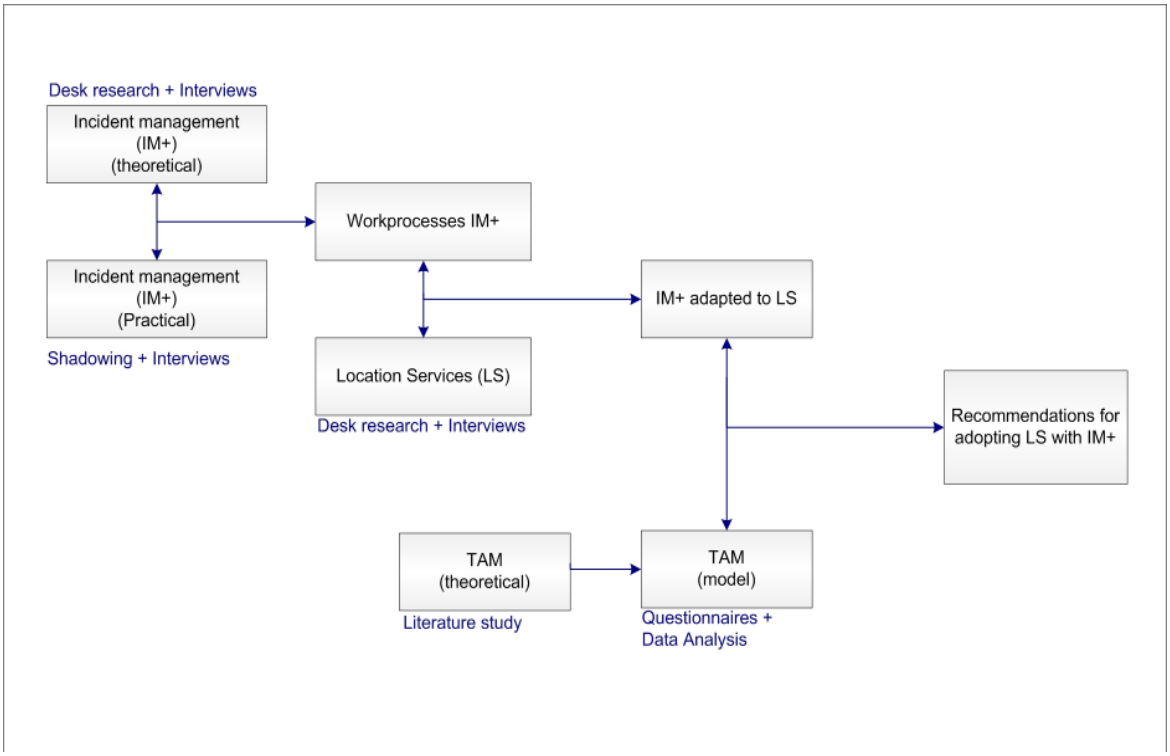


Figure 3.1: Conceptual model of the research project

3.1.1 Shadowing

Shadowing is an observation method mostly used in anthropological and ethnographic research, but can also be used on other scientific areas such as consumers behavior or software design (McDaniel and Gates, 1998). To get more insight in the work processes and activities of the Road inspectors during the normal daily operations and to structure the research in an analytical way shadowing is used in behalf of this research project.
On February 11th and February 12th, 2008 the shadowing sessions are executed in the district of Amsterdam, followed by interviews to point out the added value of LS with IM+. (In paragraph 4.1 till 4.4 the results will be highlighted).
Beside shadowing the de-briefing sessions are used for pre-testing the questionnaire for possible fine-tuning of the questions.

3.1.1.1 Preparations

Before carrying out the fieldwork there were some preparations to take care of:

- Time synchronization of all the equipment if possible (Watch, GPS, Rugged Notebook (Itronix) for route tracking, photo camera, voice recorder)
- Testing and starting up all the equipment (e.g. calibration of the GPS, route tracking application)
- Development of a fieldwork form. This form is needed to make it possible to administrate the observations in a structured way. (Appendix 2)

On this form the following subjects are made available:

- Registration of Road inspector activities
- Trigger for starting the activity
- Trigger for stopping the activity
- Information used by the Road inspector
- Information source used by the Road inspector
- Equipment used by the Road inspector
- Communication with other IM+ partners (VC-NWN, Police, etc)
- Starting time and duration of the activity

3.1.2 Questionnaire

The most common survey approaches are written mail, telephone, face-to-face and Internet Surveys. Considering the advantages and disadvantages of these methods the written mail survey is the most advantageous data collection method for this kind of research project and to collect data on the TAM's building blocks (Czaja and Blair, 2005, pg. 33). The road-inspectors work in shifts and mostly outdoors and for that are hard to reach face-to-face. Using these method the duration of the response would take to much time. A written mail survey by post would also take more time than available. To overcome this time issue an Excel-questionnaire was developed (Appendix 3.2) and was sent to the Dutch Road inspectors by E-mail. The next paragraphs explain the steps that were followed in designing the questionnaire.

3.1.2.1 Cover letter

In general questionnaires are introduced by a cover letter. A good cover letter is indispensable because it is of great influence in persuading the Road inspector to complete the questionnaire. It is important to maintain a friendly tone and keep it as short as possible. A cover letter must consist the following items (Walonick, 2003; Czaja and Blair, 2005, pg. 90-93):

- A brief motivation for the study
- Identification of the sponsors
- Mention the incentive. (e.g. a copy of the results)
- Encouragement of prompt response
- Clearness of policy of confidentiality and anonymity
- Possibility for the interviewee to contact someone for questions (e.g. phone number).
- Explanation of how responses will be used

Appendix 3.1 show that in the cover letter all these items are taken care of. Also besides this some explanation was given how to deal with the questionnaire and how the procedures were for sending in the form.
During the shadowing period and the debriefing sessions the concept questionnaire with its cover letter were tested with a small group of available road-inspectors.

The purpose of this pre-testing was to uncover possible problems and to propose possible solutions. Also this pre-testing is used to go over the cover letter to determine if this letter was sufficient enough in explaining LS and clarifying the questionnaire's procedure.

3.1.2.2 Survey Design

The first step in surveys and questionnaires is to decide what to learn. The goals of study determine whom to survey and what to ask them. Figure 3.2 shows the steps in a survey project. (CRS, 2003; Czaja and Blair, 2005).

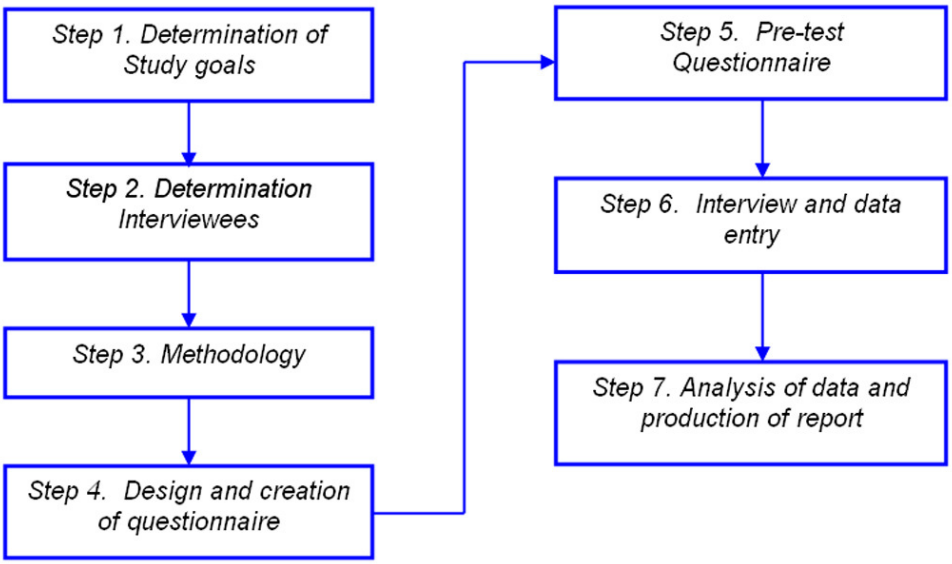
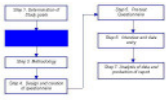


Figure 3.2: Questionnaire Flowchart

Determination of Study Goals

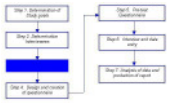
A questionnaire design should begin with well-defined study goals.

The main goal was to gain information of the opinion of the Dutch Road inspector concerning the independent variables of the adapted Technology Acceptance Model (TAM) of Davis. (Figure 3.4)



Determination of Interviewees

To establish the user acceptance when implementing LS the Dutch Road inspectors who are involved with the products and processes of IM+ were interviewed, because the knowledge of these operational procedures lies within the Operational level and the Research and Management level. These interviewees must have a good insight in the procedures and tasks of their department. They must be aware of the possibilities of LS to be able to determine if these services will benefit their procedures.
With the assistance of the department of Human Resources all the Road inspector's names and addresses were collected. The gained list was used as sample frame for this research.



Methodology

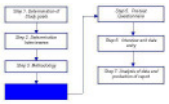
For the ability to make correct decisions accurate information is needed. In general there are several ways to gather information: (Walonick, 2003)

- Literature search.
- Talking with people
- Focus groups
- Personal interviews
- Telephone- and Mail- Survey

With questionnaires the latter two are common methodologies (Walonick, 2003; Czaja and Blair, 2005). The choice of method depends on the target group:

- When the number of interviewees is high a survey (quantitative questionnaire) would be the choice
- When the number of interviewees is low an exhaustive interview is a more common practice.

In this case (investigation of user acceptance for implementation of LS) the amount is over a hundred persons. Therefore a quantitative questionnaire was the better approach.



Design and creation of questionnaire

After the goals were defined and the method of analysis was clear the questionnaire was designed and created. In table 3.3 and table 3.4 criteria are shown which are used for designing the questionnaire. Table 3.5 show the common questions Davis had designed for his TAM.

Table 3.3: Criteria for questionnaire design (Walonick, 2003)

Criteria questionnaire
The questions must address study goals directly
The questionnaire must be short as possible
Analysis of the responds must be clear
The questionnaire must contain a well-written cover letter
The questionnaire title must be short and meaningful
The questionnaire must contain clear and concise instructions on how to complete the questionnaire.
The questionnaire must start with non-threatening and interesting items
The questions must have simple language and be to the point (short)
The questionnaire must contain free space for the interviewee to make additional comment possible
Most important items must be in the first half of the questionnaire
The questionnaire must contain the return address

Table 3.4: Criteria for question design (Walonick, 2003)

Criteria question
Questions must be non-threatening or policy on confidentiality must be clear
The answer to a question must be one-dimensional.
Multiple choice questions must accommodate all possible answers
Questions must not be ambiguous. Only one answer should be correct
Transitions between questions should be smooth (grouping similar questions)
All interviewees should be will be able to answer the question (no assumption of knowledge in the question)
Questions must not be leading towards an answer
Abbreviations should not be used

Davis' research was aimed at measuring acceptance of a new software tool by users and introduced a standard set of questions that can be used in standard TAM studies, called the *Davis' scale* (see Table 3.5)

Table 3.5: The original Davis' scale items.

Davis' Scale items	
Using ….. in my job would enable me to accomplish tasks more quickly	Perceived Usefulness
Using ….. would improve my job performance	
Using ….. in my job would increase my productivity	
Using ….. would enhance my effectiveness on the job	
Using ….. would make it easier to do my job	
I would find ….. useful in my job	
Learning to operate ….. would be easy to me	Perceived Ease of Use
I would find it easy to get ….. to do what I want to do	
My interaction with ….. would be clear and understandable	
I would find ….. to be flexible to interact with	
It would be easy for me to become skilful at using …..	
I would find ….. easy to use	

The questions that are used in this questionnaire were formulated in such a way that the answers were quantifiable. The questions for this research project allowed the participants to choose between 5 alternative answers ranging from *completely agree* to *completely disagree*. The results could then be used to draw conclusions on what factors contribute the most to the acceptance of LS.

When starting the Excel-questionnaire automatically the Road inspectors were shown a message box (Figure 3.3) which clarified the procedure of filling in the form.

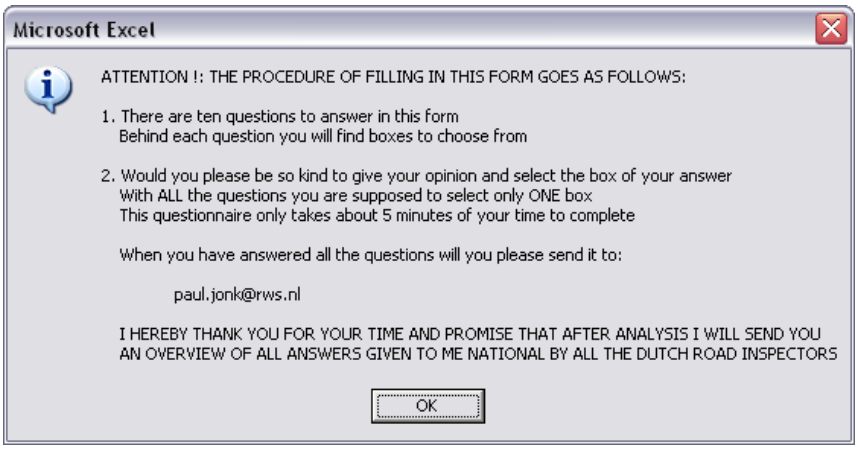


Figure 3.3: Excel-Message Box of the Questionnaire (Dutch and English version)

Pre-testing questionnaire

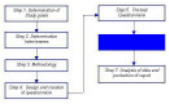
The last step in designing a questionnaire was to test the questionnaire with a small number of Road inspectors before publicize it.
The questionnaire was tested on two angles:

1. *Results*

In this case the survey was tested on the same kind of people, which were to be included in the main analysis. The questionnaire was tested on the expected outcome.

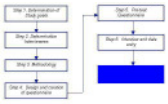
2. *Practical*

In this case the test of the questionnaire revealed some ambiguity and some other problems with question wording. It also made it clear if the Road inspectors understood the questions.



Interview and data entries

Because of the fact that the Road inspectors are working in shifts the duration of the questionnaire response was expected to take a great amount of time.
In order to reduce the time span between start and response the questionnaire was sent by Email to the coordinators/team leaders of the Road inspectors asking them to coordinate this response. The questionnaire was sent to a total amount of 283 Road inspectors on February 22nd, 2008 followed by a follow-up on March 7th, 2008. After the first invitation only 52 Road inspectors had responded. After the follow-up 75 more respondents had sent in their forms.



Analysis of data

Correlation is a statistical technique which can show whether and how strongly pairs of variables are related. A correlation coefficient is intended to measure "strength of the relationship". Correlation can be used to determine if the independent variables influence the dependent variables Usefulness and Ease-of-Use.
In this research the variables are measured on an ordinal level (from totally agree to totally disagree).

According to Blalock (1988) with ordinal variables only rank-order correlation can be calculated (Table 3.6). To determine if the independent ordinal variables of the research model (Figure 3.4) correlate with the constructs Usefulness or Ease of Use the Kendall's tau-b method is used.

Table 3.6: Possible statistical measurements and procedures (Blalock,1988).

Measurement level of first variable	Single variable procedures	Two-variable (Bivariate) procedures			
		Measurement level of second variable			
		Dichotomy	**Nominal**	**Ordinal**	**Interval and ration**
Dichotomy	Proportions, percentages, ratios	Difference of proportions, Chi square, Fisher's exact test,	….	….	….
Nominal	Proportions, percentages, ratios	Chi square,	Chi square,	….	….
Ordinal	Medians, quartiles, deciles, quartile deviations	Mann-Whitney, runs, Smirnov, signed-ranks	Analysis of variance with ranks	Rank-order correlation, Kendall's tau, gamma, r_s, d_{yz}	….
Interval and ration	Means, medians, standard deviations	Difference of means	Analysis of variance, E^2, interclass correlation	….	Correlation and regression

In 1938 Maurice George Kendall introduced the rank-order correlation coefficient which currently bears the name Kendall's tau (O'Connor and Robertson, 2003; van der Zee, 2004).

The correlation between two variables reflects the degree to which the variables are related. It ranges from +1 to -1. A correlation of +1 means that there is a perfect positive linear relationship between the variables, where 0 means no relation at all and -1 means a perfect negative relationship between the variables.

In statistics, rank-order correlation is the study of relationships between different rankings on the same set of items. It deals with measuring correspondence between two rankings, and assessing the significance of this correspondence and especially suitable for data measured on a ordinal scale.

Kendall's τ (tau)-b formula:

$$tau\ b = P-Q/SQRT((P+Q+Tx)(P+Q+Ty))$$

where Tx is the number of pairs tied on X but not Y, and Ty is the number of pairs tied on Y but not X.

As suggested in paragraph 2.3.3 the questions are formulated in such a way that the answers are quantifiable from totally agree to totally disagree. (Table 3.7)

Table 3.7: Variable Values

Variable	Value
Totally Agree	1
Agree	2
Neutral	3
Disagree	4
Totally Disagree	5

The numeric results are analysed with SPSS Version 16.0 (SPSS Corporation, Chicago, USA) for the analysis of the hypotheses to be able to draw conclusions on what factors contribute the most to the acceptance of LS.

To be able to determine the correlations per construct (PU and PEU) the answers per respondent were add up. With ordinal variables this is not a common method. Nevertheless for this research the added up values give a good indication of the Kendall's tau-b correlation coefficient.

Several Road inspectors had answered all the sub questions of PU and PEU with "Neutral". The assumption can be made that these Road inspectors instead of the neutral opinion meant "*No opinion*" or "*Don't know*".

Because of the fact that with this research we want to measure the influence of the independent variables on PU and PEU, for the correlation analysis these Road inspectors answers are treated as missing values.

3.1.3 Index of Diversity

Per sub question or statement of the questionnaire the division of the answers of the Road inspectors is measured using the *index of diversity (D*I). This measure can be used as an indication how homogeneous the Road inspectors are with their opinion. DI high stands for high diversity DI low stands for more homogeneousness.

The index of diversity formula:

$$DI = 1 - \frac{1}{n^2} \sum_{i=1}^{r} f_i^2$$

Where:

DI = Index of Diversity
n = total of units
r = total different values
f_i = frequency of the i^e value

The index of diversity of each question is shown in Appendix 5 (Frequencies per department)
However all the questions concerning "*Usefulness"* scored with a median "agree" these questions measured a high index of Diversity between 0,733 and 0,832.
Also with the construct "*Ease of Use*" the Road inspectors agreed (median) with its importance, but the large amount of "Neutral" answers show that the questions were less straightforward to answer than the questions concerning "*Usefulness*".
Approximately 68% of the Road inspectors has the Intention to Use LS with IM+ when it comes available. 25% of the Road inspectors are "Neutral" (or doesn't know)

3.1.4 Extensional Technology acceptance model of LS with IM+

The TAM of Davis was slightly adapted for the purpose of analysing the characteristics of the Dutch Road inspector and their influence on Perceived Usefulness and Perceived Ease of use of LS with IM+. Figure 3.4 shows the adapted model.

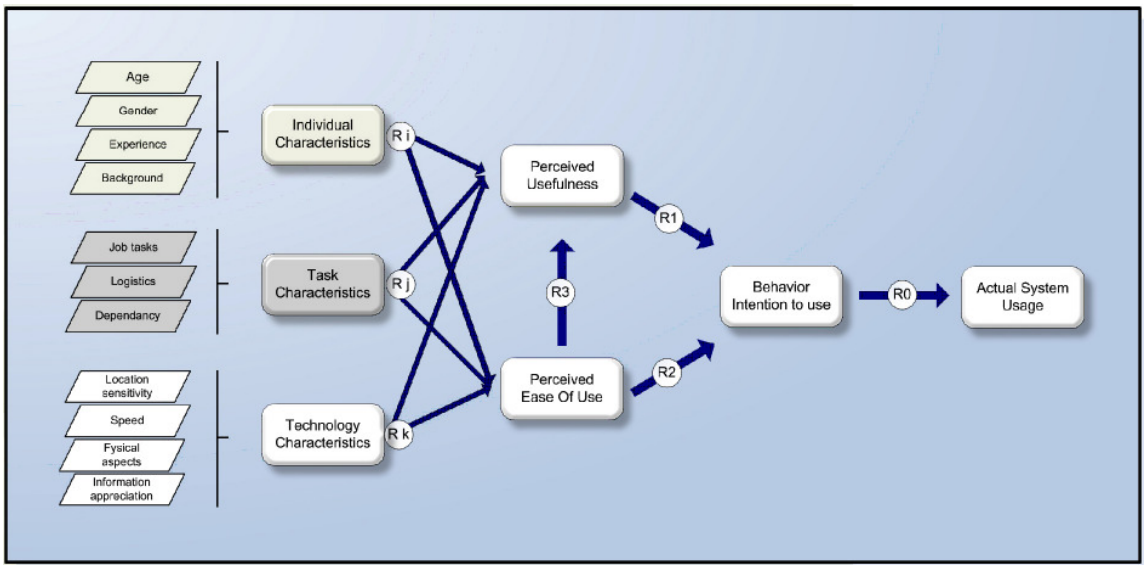


Figure 3.4: TAM adapted for LS with IM+

The parameters concerning individual characteristics, task characteristics and technology characteristics are independent of the constructs in the sense that they affect the constructs, but they are not affected by the constructs or by other parameters. The tables in Appendix 5 show the scale or questions that are asked in the questionnaire and what independent parameter they concern

The questions concerning PU were more straightforward to answer than PEU because for this latter construct the Road inspectors had not yet worked with LS and because of this lack of experience these questions were harder to answer.

3.2 Data Used

The primary data for this research project will be compiled with questionnaires sent to the Dutch Road inspectors.

3.2.1 Scale

The list of questions in the questionnaire are the scale items of the adapted TAM. The purpose of the model lies in the quantification of the relations between the different constructs defined in the model. Davis' standard set of questions (table 3.5) were slightly adapted for the purpose of understanding LS by the Road inspectors.
The scale items (the questions) were pre-tested during the debriefing sessions after the shadowing process on the 11th and 12th of February 2008. The strength of the model lies within well chosen questions. To be able to draw conclusions from the response the questions must cover the hypothesized relations.

In the hypotheses *Perceived Usefulness* will be abbreviated as *PU* and *Perceived Ease* of Use as *PEU*.

Hypothesis Ri_1: Age affects PU and PEU
Hypothesis Ri_2: Gender affects PU and PEU.
Hypothesis Ri_3: The level of experience affects PU and PEU
Hypothesis Ri_4: Background affects PU and PEU

Hypothesis Rj_1: Job tasks dependency positively affect PU and PEU
Hypothesis Rj_2: Information dependency positively affect PU and PEU
Hypothesis Rj_3: Logistics positively affect PU and PEU

Hypothesis Rk_1: Speed of Information availability affects PU and PEU
Hypothesis Rk_2: Physical aspects affects PU and PEU

Chapter 4.2 shows the results of the frequencies of the answers and the correlations which are used to determine if the hypotheses are accurate.

Costs of the new technology could have a negative affect on the usage behavior. The Dutch Road inspectors however do not have any relationship with the costs. Therefore this variable is not investigated.

Chapter 4

RESULTS

Introduction

This chapter shows the results of the investigation of the UPP and with that shows the possible added value of using LS with IM+. This chapter also covers the results of the statistic analysis of the hypotheses. Table 4.4 in paragraph 4.4 shows the possible added value of LS with the operational input of IM+

4.1 Results of shadowing

Just recently at the Traffic Control Centre of North Holland (VC-NWN) an operational Deployment Plan is introduced. This plan provides the strategically chosen locations of the Road inspectors per shift. These locations are scattered over the area in such a way that the Road inspectors are able to arrive at the scene of the incidents in their part of the area within 15 minutes (conform Service Level Agreement).
Figure 4.1 shows these locations at the traffic rush hours.

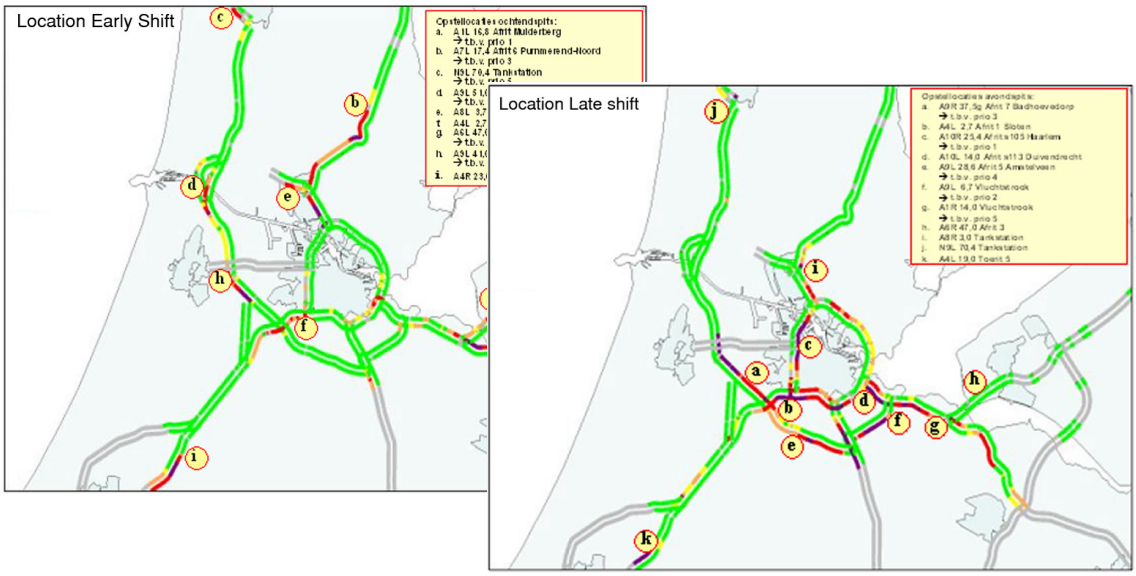


Figure 4.1: Deployment locations of the Road inspectors.

The Road inspectors are obliged to call-in at the VC-NWN to become fully operational. This 'Calling-in' is done by mobile phone. After this the Tracking&Tracing functionality of the Road inspector is put on by the VC-NWN.

All the incidents are controlled by this Traffic Control Centre, but when the Road inspector is at the scene of the incident he is fully in control of his operational actions. When the Road inspector is at the location of the incident he must call the VC-NWN to inform the traffic controller that he has arrived. When the Road inspector has finalized his actions he passes the information of his actions and the status of the incident to the VC-NWN.

During the shadowing sessions on the 11th February one small incident occurred and on the 12th February at approximately 20:00h one incident with a heavily casualty (motorcycle) occurred. For this last incident the Road inspector was asked by the KLPD to assist for taking DVM measures (appendix 1.5) and Traffic diversion (appendix 1.6). Table 4.1 shows the procedures that were tested in practice during the shadowing sessions and if they were conform the theoretical UPP.

Table 4.1: Practice versus Theoretical UPP.

UPP procedure	Conform UPP
Monitoring Assistance (appendix 1.1)	Yes
Taking Safety Measures (appendix 1.2)	Yes
Set up DVM Measures (appendix 1.4)	Yes
Divert Traffic (appendix 1.5)	Yes
Salvage & Repair (appendix 1.6)	Yes
End of Measure (appendix 1.7)	Yes
Support Emergency Services (appendix 1.3) could not be tested because the casualty was already transported with the ambulance when the Road inspector arrived at the location of the incident. For this procedure the Road inspector and the coordinator were interviewed if in practice this procedures is conform the UPP. According to the interviewees the procedure answers conform the UPP.	

4.2 Questionnaire Response

A high response rate increases the credibility of the survey's results. The findings of a survey are seen more accurate when a large percentage of its target population (Road inspectors) responds to the questionnaire, because the sample is likely to represent the overall target population. (SuperSurvey, 2005)

Low response rates are a problem to deal with. For that reason all the Dutch coordinators of the Road inspectors (spread over the Netherlands) were asked to participate in conducting the questionnaire to elicit response to guarantee a possible healthy response rate.

Also for stimulation a special designed cover letter was drawn up (Appendix 3.1).
Two weeks after the initial invitation, to induce the response, a follow up was sent with a reminder to those who had not yet responded.
Figure 4.2 and table 4.2 show the total amount of sent questionnaires per district and the response rate. The response rate show that the regions are not overrepresented or underrepresented

Figure 4.2 : Map of the Dutch Districts of RWS

Table 4.2: Amount of questionnaires sent versus response

Department	Forms Sent	Response	Response Rate
Noord-Holland	19	11	**58%**
Zuid-Holland	71	31	**44%**
Zeeland	14	6	**43%**
Noord-Nederland	15	10	**67%**
Oost-Nederland	77	27	**35%**
Utrecht	39	16	**41%**
Noord-Brabant	20	11	**55%**
Limburg	28	15	**54%**
Total	**283**	**127**	**45%**

Possible reasons for giving the questionnaire a low priority:

- The Road inspector works approximately 80% outdoors. When he or she is at the office other duties are taken care of.
- After six weeks I started the statistic analysis of the response. Perhaps due to the lack of time the period of six weeks could be a reason for nonresponse. (After the analysis period seven more responds were returned)

4.3 Functional design of Proof-Of-Concept

To demonstrate the feasibility of a business model for LS with Incident management a proof-of-concept (POC) was planned to be tested with the Road inspectors of Utrecht. For this the output of the shadowing process is used as a basis for the fine-tuning of this business model. Because the POC was not yet available at the time this research took place investigation of this POC goes beyond of the scope this research.
An overview of the Road inspector's requirements and motivation are shown in appendix 4, Table A4.1 till Table A4.4.

4.4 Possible added value using LS with IM+

Table 4.3: Possible added value of LS with IM+

IM+ Now	IM+ adapted with LS	Benefits
Registration of time of incidents calls after the undertaken actions	automatically time registration	completeness; accurateness
Printing of digital photographs to put with the damage-report	photograph integrated in application and direct available with the damage-report	efficiency work process; speed; reduction of failures
status of actions of Road inspector unknown at the Traffic Control centre and the district office	automatically message of location and status when road-inspectors vehicle stop at the scene.	safety; sharing information; efficiency work process; cooperation with other IM+-partners
Administration takes much time and effort. Usefulness is considered as not clear and boring	administration partly automatically. Faster executed process.	motivation;
Hand written registration	digital form on dashboard tablet PC	less afterworks.
Registration terminology not clear. Confusional notes as "Call with VC-NWN" (who calls who?)	clear procedure, (pulldown-menus;	uniform registration; completeness; consistency (less confusion)
overlapping registration of information in multiple forms/reports	One time registration, automatically generated reports; automatically generated emails to partners involved	not double work; control; communication less time consuming
time registration by watch of Road inspector. Location with BPS method	Time and location automatically registered through GPS	accuracy
No insight in surrounding area of incident	awareness of surroundings	better decision taking of actions
Traffic measurements are asked by the Road inspector with the Traffic control Centre by phone	more detailed information	Better judgment of supplies and resources

Not only the IM+ operational tasks would benefit the usage of LS. As mentioned in chapter 1.3 in January 2005 a business case was drawn up by the SPINlab, Amsterdam, which proved that IM+ could benefit significantly in efficiency when implementing LS (Beinat et al, 2005). One of the products of this business case is Table 4.4 showing the impact and added value on the IM+ work processes. The outcome of the shadowing sessions show that this table is proved to be still valid.

Table 4.4 : Impact and added value of LS of IM+ processes (Beinat et al, 2005)

	Process Indicator	Preparation and Logistics	Execution	Administration	Intelligence
Field Output	*Efficiency* (uniform sources, faster output)	-/-	■■	■■■	-/-
	Effectiveness (uniform sources, better output)	-/-	■■	■■■	-/-
	Quality of information and products	-/-	■■	■■■	-/-
Organization	*Efficiency, Coordination*	■■■	■■■	-/-	■■■
	Quality of information and products	-/-	■■	■■■	■■
	Impact on other processes	■	-/-	■■■	-/-
	Flexibility of the organization	■	■■■	■■	■
	Cooperation with other organizations	■■■	■■■	-/-	■■
Road inspectors	Motivation and commitment	■■■	■	■■	■■
	Personal Safety	-/-	■■■	-/-	-/-

-/- = No Impact or neglectable Impact;
■ = Positive identifiable Impact, but no or minor change of work processes
■■ = Positive identifiable Impact, with sometimes a change of the work processes
■■■ = Significant Impact, capable of changing the work processes

4.5 Statistic Analysis of Questionnaire

4.5.1 Frequencies

To give an overview of the results of the response appendix 5 shows the frequencies per question per department and the total amount. The graphical presentations of the percentages per question are shown in appendix 6.
Overall the frequency tables and charts show a positive attitude towards the use of LS. Only two Road inspectors indicated no intention to use LS with IM+ at all (totally disagree) and five Road inspectors disagreed with the intention to use. These seven Road inspectors has no similarity of independent variables.

4.5.2 Hypotheses

A number of standard measures and methods are used with SPSS 16.0 to process and evaluate the questionnaires in order to find indications of their influence on PU, PEU and Intention to Use and to see whether the results support the hypotheses that were introduced in paragraph 3.2.1.

Hypothesis Ri_1: *Age affects PU and PEU*

At this moment the average model of the Dutch Road inspector is approximately 42 years old with a MBO education level. This MBO education level can be compared with high School. (Table 4.5).

Table 4.5 : Age * Education Crosstable

Age * Education Crosstabulation						
amount		Education				
		Secondary School	LBO	MBO/ High School	HBO/ College	Total
Age	20 - 24	0	0	2	1	3
	25 - 29	1	0	9	0	10
	30 - 34	0	0	12	1	13
	35 - 39	1	3	19	1	24
	40 - 44	1	6	23	1	31
	45 - 49	2	3	11	1	17
	50 - 54	0	4	8	1	13
	55 - 59	0	2	11	0	13
	55 - 60	0	1	1	0	2
	Total	5	19	96	6	126

The suggestion was made that the younger in age the higher the perceived usefulness and ease of use. However the Kendall's tau-b correlation (table 4.6) shows that with the values PU: 0.028; PEU:-0.024 and Intention to Use: 0.038 the correlation is close to zero. With that the next conclusion can be made

Table 4.6: Kendall's tau-b correlation Age * PU and PEU

Kendall's tau_b		Age (Mean)	added up value PU	added up value PEU	When LS becomes available to me I am intent to use LS
Age (Mean)	Correlation Coefficient	1,000	,028	-,024	,038
	Sig. (2-tailed)	.	,688	,732	,625
	N	115	115	113	114

Conclusion:

1. Perceived Usefulness (PU) and Perceived Ease Of Use (PEU) are not dependent with the Age of the Road inspector

2. Age does not affect the intention to Use LS with IM+

Hypothesis Ri_2: *Gender affects PU and PEU*.

Measurement of the correlations of Gender with PU, PEU and Intention to Use showed that these correlations were close to zero. However due to the fact that there were only a few female responses investigation of this Hypothesis would not give a reliable conclusion and therefore these figures can be regarded.

Hypothesis Ri_3: *The level of experience affects PU and PEU*

The assumption was that more experience in working with IT-related matters or Spatial Information, because of the acquaintance with this technology, would enhance the PU, the PEU and Intention to Use.

The correlation values (Table 4.7) between -0.055 and 0.061 show that working with Spatial Information has no affect on PU and PEU.
There is a weak correlation between work experience and PU and PEU (PU: 0.408; PEU: 0.404). Therefore the next conclusions are drawn:

Table 4.7: Kendall's tau-b correlation Level of Experience * PU and PEU

Kendall's tau_b		PU added up value	PEU added up value	When determining my routes I often use route-navigation systems	I prefer working with maps than written text	I have no problem showing someone the way	I think the usage of LS agrees with the way I prefer to work
PU (added up value)	Correlation Coefficient	1,000	,527	,036	,041	-,002	,408
	Sig. (2-tailed)	.	,000	,619	,575	,976	,000
	N	116	114	115	115	115	114
PEU (added up value)	Correlation Coefficient	,527	1,000	-,055	,021	,061	,404
	Sig. (2-tailed)	,000	.	,450	,779	,426	,000
	N	114	114	113	113	113	112

Conclusion:

1. Low usage of GIS related IT and geographical experience do not affect PU and PEU

2. The Road inspector perception of LS with the way he/she prefers to work seems to have a positive influence on PU and PEU

Hypothesis Ri_4: *Background affects PU and PEU*

Because the questionnaires were promised to be analysed anonymously the background variable only concerns the educational level of the Road inspectors.
As table 4.5 shows over 76% of the respondents are of MBO educational level. This level can be compared with the High School level. Approximately 19% has a lower level of education and 5% is of College level.
The analysis if education is of influence on PU and PEU shows with the measured correlation coefficients (PU: 0.147; PEU: 0.090; Intention to Use: 0.076) that there is no significant correlation between education and PU and PEU (Table 4.8).
Because the low diversity in education could be an explanation of the low correlations the following conclusion can be made:

Table 4.8: Kendall's tau-b correlation Education * PU, PEU and Intention to Use

Kendall's tau_b		PU added up value	PEU added up value	When LS becomes available to me I am intent to use LS	Education
PU (added up value)	Correlation Coefficient	1,000	,527	,571	,147
	Sig. (2-tailed)	.	,000	,000	,054
	N	116	114	115	116
PEU (added up value)	Correlation Coefficient	,527	1,000	,542	,090
	Sig. (2-tailed)	,000	.	,000	,252
	N	114	114	113	114
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,571	,542	1,000	,076
	Sig. (2-tailed)	,000	,000	.	,376
	N	115	113	115	115

Conclusion:

1. Education does not seem to affect PU and PEU
2. Education does not seem to affect the Intention to Use
3. PU and PEU have a positive affect on Intention to Use

Hypothesis Rj_1: *Job task Dependency positively affect PU and PEU*

The relatively low index of diversity of the answers to the questions concerning task dependency and the overall median "*Agree*" show that the Dutch Road inspector is well aware of the fact that he or she is part of a cooperative chain. The Kendall's tau-b correlations (Table 4.9) however indicate that Job task dependency is of no influence on PU, PEU and Intention to Use. (PU: -.023 till 0.079; PEU:-0.103 till 0.66; Intention to Use:0.030 till 0.144)

Conclusion:

1. Job Task Dependency does not affect PU and PEU and Intention to Use.

The frequency tables and indexes of diversity show a cooperation with the different IM+ partners.

Table 4.9: Kendall's tau-b correlation Job task Dependency * PU, PEU and Intention to Use

Kendall's tau_b		PU added up value	PEU added up value	When LS becomes available to me I am intent to use LS	With IM+ I cooperate with other partners
PU (added up value)	Correlation Coefficient	1,000	,527	,571	,056
	Sig. (2-tailed)	.	,000	,000	,480
	N	116	114	115	115
PEU (added up value)	Correlation Coefficient	,527	1,000	,542	,064
	Sig. (2-tailed)	,000	.	,000	,427
	N	114	114	113	113
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,571	,542	1,000	,132
	Sig. (2-tailed)	,000	,000	.	,138
	N	115	113	115	114

Kendall's tau_b		When carrying out my tasks with IM+ others are dependant on me	When carrying out my tasks with IM+ I am dependant on others	When carrying out my tasks with IM+ I take the decisions myself	When carrying out my tasks with IM+ I am managed by others
PU (added up value)	Correlation Coefficient	,038	,079	,056	-,023
	Sig. (2-tailed)	,612	,293	,471	,761
	N	115	115	115	115
PEU (added up value)	Correlation Coefficient	,010	,059	,066	-,103
	Sig. (2-tailed)	,891	,442	,405	,173
	N	113	113	113	113
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,059	,124	,144	,030
	Sig. (2-tailed)	,484	,141	,098	,718
	N	114	114	114	114

Hypothesis Rj_2: *Information Dependency positively affects PU and PEU.*

To be able to handle rapidly reliable up-to-date information is of crucial importance. (L.H. Immers, 2007. pg 42). The assumption was that the Dutch Road inspectors were more willing to adopt LS when they were more dependent on information.

Considering the fact that all the correlations are a bit low with the Kendall's tau-b correlations PU:0.385, PEU:0.375 and Intention to Use:0,421 the Dutch Road inspector seems to indicate that sharing real-time available information is important. (Table 4.10). With that the next conclusions can be made:

Conclusion:

1. Information is important for the Road inspector and with that seems to have a positive affect on PU, PEU and Intention to Use

Table 4.10: Kendall's tau-b correlation Information Dependency * PU, PEU and Intention to Use

Kendall's tau_b		PU added up value	PEU added up value	When LS becomes available to me I am intent to use LS	For me it is important to have the required information available promptly	For me it is important that all the partners involved have the same information available.
PU (added up value)	Correlation Coefficient	1,000	,527	,571	,346	,385
	Sig. (2-tailed)	.	,000	,000	,000	,000
	N	116	114	115	116	116
PEU (added up value)	Correlation Coefficient	,527	1,000	,542	,331	,375
	Sig. (2-tailed)	,000	.	,000	,000	,000
	N	114	114	113	114	114
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,571	,542	1,000	,342	,421
	Sig. (2-tailed)	,000	,000	.	,000	,000
	N	115	113	115	115	115

Kendall's tau_b		I don't mind to share my information with the IM+ partners	For me it is important to have a direct on-line connection.	Without up-to-date information I can not do my work properly	I am missing information to do my IM+ tasks properly
PU (added up value)	Correlation Coefficient	,187*	,349	,221	,186*
	Sig. (2-tailed)	,012	,000	,003	,012
	N	116	116	115	115
PEU (added up value)	Correlation Coefficient	,280	,282	,176*	,084
	Sig. (2-tailed)	,000	,000	,018	,270
	N	114	114	113	113
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,332	,346	,185*	,217
	Sig. (2-tailed)	,000	,000	,025	,010
	N	115	115	114	114

Hypothesis Rj_3: *Logistics have a positive affect on PU and PEU*

With Logistics the up-to-date information about the location of the resources is meant and how easy the Dutch Road inspector can find this relevant information, if needed.
The Kendall's tau-b correlations of Logistics with PU and PEU (PU: -.032 till 0.086; PEU:-0.059 till 0.084; Intention to Use:0.030 till 0.144) indicate that Logistics have no influence on PU, PEU and Intention to Use. But when it comes to the knowledge of the whereabouts of the colleagues the correlations are much higher (PU:0,577; PEU:0,558; Intention to Use:0,589) (Table 4.11)

Conclusion:

1. Information of the location of the Resources does not affect PU, PEU and Intention to Use

2. Information of the location of the partners (tracking & tracing) seems to have a positive affect on PU, PEU and Intention to Use

Table 4.11: Kendall's tau-b correlation Logistics * PU, PEU and Intention to Use

Kendall's tau_b		I always know exactly the location of my partners	By using LS as information service I have a better insight in the location of my resources	By using LS as information service I can be better deployed	I always know exactly where to find my resources
PU (added up value)	Correlation Coefficient	,577	-,032	,460	,086
	Sig. (2-tailed)	,000	,666	,000	,242
	N	116	116	116	116
PEU (added up value)	Correlation Coefficient	,558	-,059	,457	,084
	Sig. (2-tailed)	,000	,428	,000	,262
	N	114	114	114	114
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,589	-,165	,488	-,076
	Sig. (2-tailed)	,000	,046	,000	,356
	N	115	115	115	115

Hypothesis Rk_1: *Speed of information availability has a positive affect on PU and PEU*

Considering the fact that all the correlations are a bit low with the Kendall's tau-b correlations PU:0.346, PEU:0.331 and Intention to Use:0,342 the Dutch Road inspector seems to indicate that prompt availability of real-time information is important (Table 4.12). Also the added comment which was sent with the response showed a common concern about the speed of information availability. Therefore the next conclusions can be made:

Conclusion:

1. Speed of Information availability seems to have a positive affect on PU, PEU and Intention to Use

Table 4.12: Kendall's tau-b correlation Speed of Information availability * PU, PEU and Intention to Use

Kendall's tau_b		PU added up value	PEU added up value	When LS becomes available to me I am intent to use LS	For me it is important to have a direct on-line connection.	For me it is important to have the required information available promptly
PU (added up value)	Correlation Coefficient	1,000	,527	,571	,349	,346
	Sig. (2-tailed)	.	,000	,000	,000	,000
	N	116	114	115	116	116
PEU (added up value)	Correlation Coefficient	,527	1,000	,542	,282	,331
	Sig. (2-tailed)	,000	.	,000	,000	,000
	N	114	114	113	114	114
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,571	,542	1,000	,346	,342
	Sig. (2-tailed)	,000	,000	.	,000	,000
	N	115	113	115	115	115

Hypothesis Rk_2: *Physical aspects have a positive affect on PU and PEU*

Beside IM+ duties the Dutch Road inspector has also the responsibility of inspection of the area and administration of the status of the traffic signs. For this the device must have the ability of mobile use. The Kendall's tau-b figures of the mobility of the device however showed a low correlation. (PU:0.260, PEU:0.201 and Intention to Use:0,263)
Screen size and readability scored a little higher. (Table 4.13). According to the added comments of the questionnaire a well working device is crucial. Therefore the next conclusions can be made:

Conclusion:

1. Physical aspects seem to have some positive affect on PU, PEU and Intention to Use

Table 4.13: Kendall's tau-b correlation Physical aspects * PU, PEU and Intention to Use

Kendall's tau_b		The screen must have a good readability at all times.	For me the dimension of the screen is important	For me it is important to have the possibility of taking the device with me	The mobile device must be waterproof.
PU (added up value)	Correlation Coefficient	,318**	,310**	,260**	,126
	Sig. (2-tailed)	,000	,000	,000	,084
	N	116	116	116	116
PEU (added up value)	Correlation Coefficient	,283**	,238**	,201**	,110
	Sig. (2-tailed)	,000	,002	,007	,142
	N	114	114	114	114
When LS becomes available to me I am intent to use LS	Correlation Coefficient	,264**	,270**	,263**	,109
	Sig. (2-tailed)	,003	,001	,001	,186
	N	115	115	115	115

4.5.4 Inter-construct correlations

For measuring the inter-construct correlation the Kendall's tau-b method is used. The results showed correlations that both perceived usefulness and perceived ease of use seems to have a positive impact on the user's intention. Additionally, perceived ease of use was found to have a positive affect on perceived usefulness. Location Services seem to be perceived to be useful and with that the Road inspectors will have a positive attitude toward their benefit.

The results that models the strengths of the Road inspector are displayed in Figure 4.3. As expected all the relationships have a positive correlation and be significant at the 0,01 level (2-tailed).
Perceived Usefulness is a stronger construct than Perceived Ease of Use.

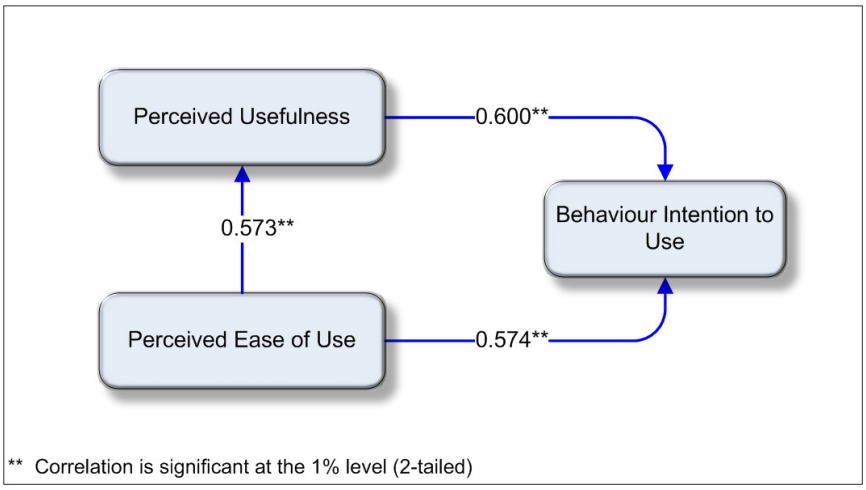


Figure 4.3: Correlation's strength between the constructs (Kendall's tau-b coefficients)

DISCUSSION

The aim of this research project was to explore and to model the acceptance and usage behavior factors of the Dutch Road inspectors of Location Services with Incident Management. Because the Proof-of-concept or demonstrator was not yet available at the time this research took place the results can be interpreted as the outcome of the theoretical part. To be able to sketch the whole picture further practical study is necessary.

5.1 Discussion

Shadowing

The purpose of the Shadowing sessions was to point out if the procedures in practice answer the theoretical UPP. The two days of shadowing followed by interviews showed that the Road inspector execute his or her IM^{+}-duties conform the theoretical UPP. Therefore the UPP can be used to investigate if LS can be an added value for IM+.

The pre-testing phase gave more insight in the reading skills of the Road inspectors. Because some terminology was not fully understood by the mirror-group some questions were adapted to a less technical format.

Other Studies

In 2005 Alfred Wagtendonk stated (Beinat et al, 2005. pg. 21), with an example during a shadowing session, that in practice the deployment of the Dutch road inspectors does not work as efficient as it was supposed to be. It is often the case that the road inspector makes decisions on his own, before deliberating with the Traffic Control Centre.

This difficulty was also previously established in the “bottleneck-matrix” of Berenschot (Rijkswaterstaat VCNL, 2003. pg 8-9). This makes the tracking&tracing functionality of LS even more useful for the IM+ processes to clarify the whereabouts of the road inspectors. This could also mean that repeating the shadowing sessions with other Districts could be advised for the determination of the accuracy of the practical execution of the UPP.

LS

This MSc dissertation shows a potential added value of using Location Services with IM+, stated in paragraph 4.4.
The location Services described in paragraph 2.2 would certainly benefit the procedures of IM+ (Appendix 1). An extensive investigation is already executed in 2005 by the Spinlab in Amsterdam (Beinat et al, 2005) that confirms the findings of this research project.

Questionnaire

In 2002 Edwin Wisse investigated the user acceptance of earth observation by GIS users. For gaining the required information for his TAM research method he chose to conduct his questionnaire approach in an artificial, controlled environment. A so called laboratory setting is the most controlled environment. During this classroom sessions his subjects got information and gave their answers under controlled conditions. (Wisse, 2002).
In his study of user acceptance of using LS in Natural Parks Eduardo Dias (2007) used the questionnaire approach for his TAM after giving his subject a briefing how to use LS. A part of the visitors who agreed to participate in his study were given a PDA to access the Information in the field real-time. Afterwards they had to complete their questionnaire. (Dias, 2007)

In this case (investigation of user acceptance for implementation of LS with IM+) the classroom approach and face-to-face method would take to much time, because the Dutch Road inspectors work in shifts and mainly outdoors. Also the Proof-of-Concept or demonstrator was not yet available when executing this MSc research. Therefore the quantitative questionnaire by email was the better approach. (Czaja and Blair, 2005)
By involving the coordinator per district in conducting the email questionnaire approach (coordination) some disadvantages (e.g. low response rate) were taken care of. Although the response was managed by their own coordinator of each district a follow-up reminder was necessary to got the required amount of response. A possible reason of being reticent in the first place could be the timing of this questionnaire or the fact that because of the IM+ a lot is happening with the work processes of the Dutch Road inspectors. Having the right or wrong timing for conducting a questionnaire could influence the outcome. Reorganization of the Dutch districts has taken place in 2005. Several districts were clustered together. If the Road inspector at that moment took part of the reorganization of his

department the willingness to respond on the questionnaire could possibly diminish.

With the introduction of IM+ the work processes of the Dutch Road inspector changed dramatically. Because of this a lot of questionnaires had to be filled in by the Road inspectors. If the Road inspector in person had got a lot of questionnaires in a short period the respond on the questionnaire could also possibly diminish. At this moment the district of Utrecht takes part of a test with a Proof-of-Concept of LS. The districts of Noord-Holland, Oost-Nederland, Noord-Nederland and Noord-Brabant take part of a project with the implementation of a mobile GIS application, named 'Mobile KernGIS'. This application has no LS functionality at this moment. Synchronization must be executed at the office.

Knowing these facts the response-rate of 45% could be considered as high.

TAM

Despite the relatively low correlation the Information component has a significant positive influence on all the constructs that influence adoption. This suggests that, if the information addresses the criteria stated in paragraph 2.2.5, the Road inspectors are more likely to use LS in future.

The lack of experience of working with LS or demonstrative model seems to influence the correlations outcome. However the medians of all the questions on PU and PEU scored a positive answer, interestingly PEU shows more "neutral" response than PU

Other Studies

As mentioned above in 2007 Eduardo Dias used the similar TAM approach of Davis for his research of technology acceptance of Mobile Information Services (LS) by visitors of National parks. The visitors had the availability of a mobile device (PDA) and were delivered information in the field (wireless), dependent on their location (Push-service). It also enabled the visitors to request information from databases using their mobile device (Pull-service) (Dias, 2007). For analysis Dias used the comparable Spearman's rank correlation coefficient to reveal the relationships. (Unesco, 2007). The Spearman's test is also a non-parametric measure of correlation that does not make assumptions on the frequency distribution of the variables, and, additionally, it does not require that the relationship between the variables should be linear. (Dias, 2007, pg 177)

Because of the use of ordinal variables in my MSc research project according to Blalock (1988) the rank-order correlation Kendall's tau-b method had to be used (Table 3.6)
Comparing the results of the Road inspector with the inter-constructs correlations of the visitors of the National parks it is striking how similar the figures are. (Figure 5.1)

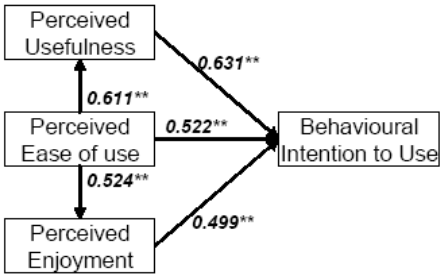


Figure 5.1: Inter-construct correlations of visitors of the National park (Dias E.S, 2007. pg 177)

Dutch Road inspector

The population of Dutch Road inspectors can be considered a rather homogeneous group. But the indexes of diversity of the questions showed a relatively high variety of the answers. This was not explained by the age variety or working in other districts. Presumably the homogeneousness and the too theoretical questions, due to the lack of experience, could be the cause that all the correlations were a bit low.
Despite of these low correlations we can make some assumptions of the usage behavior of the Dutch Road inspectors.

The following aspects could benefit the adoption and intention to use LS with IM+:

- The Road inspector perception of LS with the way he/she prefers to work seems to have a positive influence on the usage behavior.
- Up-to-date information is important for the Road inspector and with that seems to have a positive affect on the usage behavior.
- Information of the whereabouts of the partners (tracking & tracing) seems to have a positive affect on the usage behavior.
- Speed of information availability (fast network) seems to have a positive affect on the usage behavior.
- The mobile device must operate well at all times. This also seems to be important for the usage behavior.

Aspects that do not have affect on the usage behavior are:

- The age of the Road inspector.
- Low usage of GIS related IT and geographical experience.
- The educational level of the Road inspector.
- Job Task Dependency
- Information of the location of the Resources.

CONCLUSIONS

6.1 Conclusions

IM+

The Dutch Highway authority is committed to implementing Incident Management (IM+) measures on the national Dutch motorway network to deal with traffic congestions to prevent not only physical damage but also the related economical and social damage. The aim of these IM+ measures is to ensure the safe and rapid handling of incidents so that the traffic flow restrictions caused by an incident are lifted as quickly as possible. Because in practice, this means some technical measures and co-operation between the RWS and professional emergency services, available up-to-date information is of crucial importance (Immers, 2007. pg 42).

LS

Location Services (LS) have the quality to give fieldworkers like the Road inspectors and the cooperative partners the opportunity to access data and geo-information real-time in the field, dependant of his or her location. This quality makes it possible for all the partners involved to deal more efficiently with the means of communication and accessibility of this information. Also the Traffic Control centre has more insight of the whereabouts of the Road inspectors (Tracking&Tracing.)

Possibilities LS with IM+

Not only the IM+ cooperation with other emergency services would benefit the usage of LS, but also the Road inspectors would gain an added value with LS for the work processes *Execution* and *Administration* (see Table 4.4). LS give the possibility of a two-way communication and interaction. Because *Time* is an important aspect of IM+ the best way to clarify the contribution of LS is to investigate on this aspect.

User Acceptance

When reviewing the literature the Technology Acceptance Model (TAM) of Davis seemed very applicable when investigating the acceptance and usage behavior factors of the Dutch Road inspectors. (Napaporn Kripanont, 2007; Horton et al, 2001; Dishaw and Strong, 1999; Dias, 2007). However an important question raises by the results of this research if the TAM can potentially be applied in a phase where a new technology is not yet been introduced.

The low correlations and the relatively high indexes of diversity show that the usage of the TAM in this phase seems less usable. Presumably the lack of experience made the questions in the questionnaire too theoretical.
In the original TAM study Davis already concluded that perceived usefulness (PU) is a major determinant of intention whereas perceived ease of use (PEU) is only a secondary determinant of intention (Davis et al, 1989). In this research both the PU and PEU constructs measured a relatively weak correlation. The adapted TAM however could be applicable for research of the user acceptance of LS with IM+ after the Road inspectors have had hands-on experience with the new technology.
The usage of the questionnaire survey sent by email, followed by a follow-up reminder and coordinated by the coordinator per district has proved to be a good method of primary data collection. Considering the fact that these Road inspectors work in shifts and outdoors (24-7) and the fact that lately a number of questionnaires has passed their way (questionnaire tiredness) the response of 45% can be assumed is to be high.

Dutch Road inspector

To make LS successful with IM+ the usage behavior of the Dutch Road Inspector must be taken into account. After this research project some assumptions of the usage behavior of the Dutch Road inspectors can be made: Age, the educational level of the Road inspector and the experience of GIS related matters do not influence the intention to use LS.
Matters that seem to influence the usage behavior of the Dutch Road inspectors positively are: The Road inspector's perception of LS with the way he/she prefers to work; Up-to-date available information; Information of the locations of the partners, Speed of information availability (fast network) and last but certainly not least the mobile device must be of reliable good quality, built-in applicable for their vehicle and must work at all times.

The fact that the Dutch Road inspector seems willing to adopt LS with IM+ contributes to the commitment of RWS to alleviate the traffic flow restrictions and with that diminish the economical and social discomforts.

6.2 Recommendations

Reflection

I would like to conclude this dissertation with a number of personal reflection issues.

Each question in the questionnaire was regarded to be unambiguously formulated. However the sequence of some questions (the sub questions 10.1 till 10.4) caused a slight multi interpretation. Because of this in future also the sequence of the questions should be taken into account. Also with the questions or statements the "*neutral*"-opinion could be interpreted as "*don't know*". This gives another nuance than the opinion "neutral".

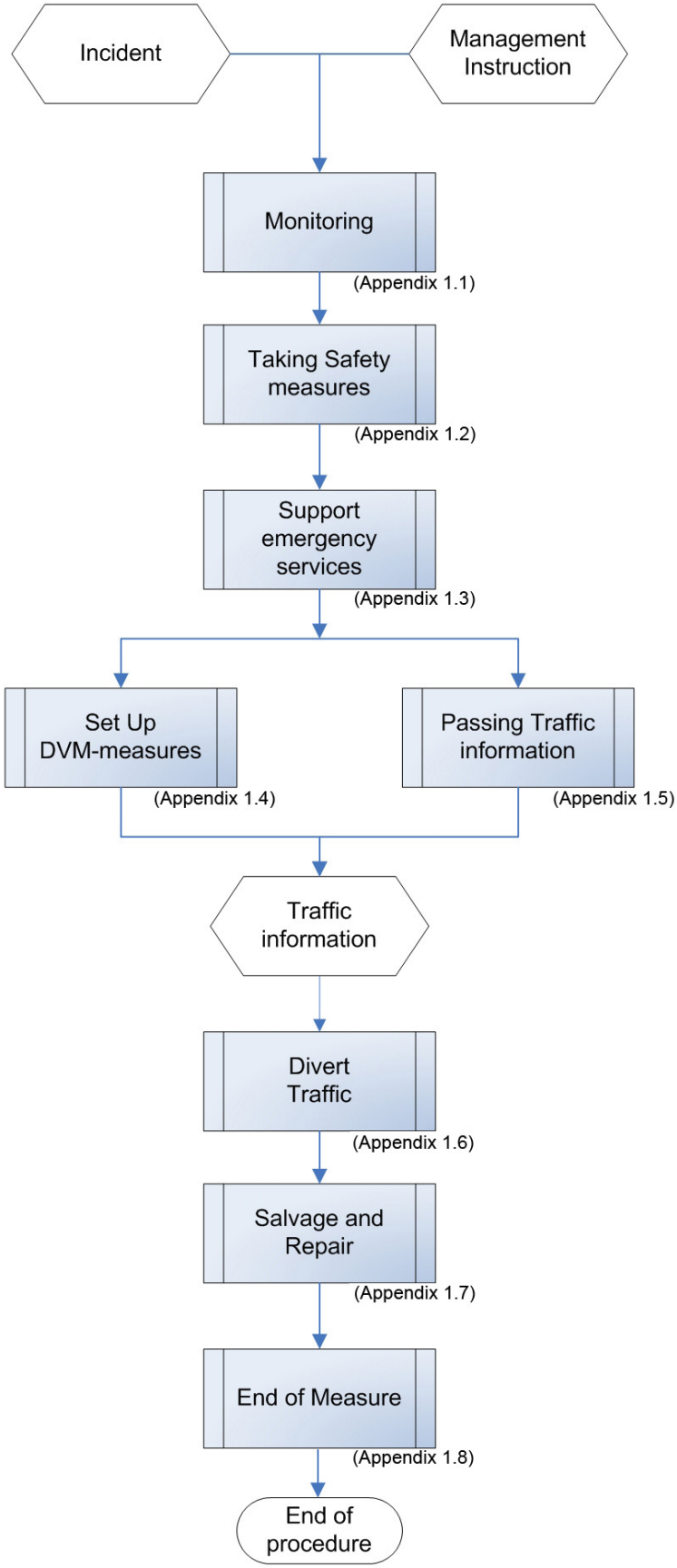
When starting the Excel-questionnaire automatically the Road inspectors were shown a message box (Figure 3.3, paragraph 3.1.2.2) which clarified the procedure of filling in the form, beginning with the sentence "*There are ten questions to answer in this Form*". In fact these were main questions which contained a couple of sub questions. In future it is better not to say how many questions there are, but only the approximately amount of time it will take to fill in.

Further Study

As mentioned in paragraph 6.1 the adapted TAM could be applicable for research of the user acceptance of LS with IM+ the Road inspectors when LS is made available to work with. A recommendation would be to carry out an additional study using the current model considering the next issues:

1. Because of the constructs PU and PEU the additional study should be performed after a demonstrator or Proof-of-concept is introduced. Then the interviewees have hands-on experience and with that have a better understanding of the introduced technology.
2. Formulating questions matching the construct Perceived Ease of Use (PEU) proved to be difficult. These questions should be evaluated if they cover the affect on the construct.
3. It is better to use questions with values on an interval level instead of using values on an ordinal level. Analysis of this response give more possibilities. (e.g. regression, standard deviations)

APPENDIX 1. IM+ (UPP) Work Process - (RWS)



APPENDIX 1.1 (IM+) Monitoring Assistance

Organization Role	*Coordinating Highway Traffic Controller*	*Highway Traffic Controller*	*Road inspector*	*National Highway Traffic Controller*	*Travel Information Operator*	*KLPD / regional police force*
Task	Decide	Execute	Contribute	Contribute	Contribute	Contribute
Document	*Reference Values Traffic Management*	*Reference Values Traffic Management*	*Deployment Plan Traffic management*	*Deployment Plan Traffic management*	*Scenario Traffic Management*	
Systems	DVM-system & Cameras / Fax & ChatboxInfo / Logging					
Activity		Monitor traffic conform reference values of traffic flow. Inform KLPD. Process information of KLPD. Direct Road inspector to location incident for additional information. Logging incident-administration. Coordinate priority.	Monitor 'hot-spots'. Supervise conform scenario. Inform highway traffic controller of location and additional information of incident			Monitor 'hot-spots'. Supervise conform scenario. Inform highway traffic controller of location and additional information of incident

APPENDIX 1.2 (IM+) Taking Safety Measures

Organization Role	*Coordinating Highway Traffic Controller*	*Highway Traffic Controller*	*Road inspector*	*National Highway Traffic Controler*	*KLPD / regional police force*
Task	Decide	Execute	Contribute	Advise	Contribute
Document	*RWS Agreement.*	*RWS Agreement.*	*Calamity Plan.* *Guideline first safety-measures with incidents*	*RWS Agreement.*	
Systems	Logging				
Activity		Barrier cross Traffic lane. Speed limit measure. Head Road inspector and other Emergency services to location incident. Inform KLPD + VCNL.	Take care of physical safety measures on location. Request speed limit Take care of traffic control. Inform Highway Traffic Controller.		

APPENDIX 1.3 (IM+) Support Emergency Services

Organization Role	*Coordinating Highway Traffic Controller*	*Highway Traffic Controller*	*Road inspector*	*National Highway Traffic Controller*	*Travel Information Operator*	*KLPD / regional police force*
Task	Decide	Execute	Contribute	Must be informed	Must be informed	Advise
Document	*RWS Agreement.*	*RWS Agreement.*	*RWS Agreement.*	*Guideline first safety-measures with incidents*		*RWS Agreement.*
Systems	-					
Activity		Support emergency services. (routing). Inform Road inspector. In case of big incident - hand over to CTPI	Support emergency services if necessary (life-saving). In case of big incident support CTPI. Decide to put crisis procedure into operation			

APPENDIX 1.4 (IM+) Set Up DVM measures

Organization Role	*Coordinating Highway Traffic Controller*	*Highway Traffic Controller*	*Road inspector*	*Districts Coordinator*	*Travel Information Operator*	*KLPD / regional police force*
Task	Decide	Execute	Contribute	Contribute	Contribute	Contribute
Document	*Reference Values Traffic Management*	*Deployment Plan*	*Scenario Traffic Management*	*Scenario Traffic Management*	*Scenario DVM-measures with incidents*	
Systems	Logging / Roadside systems					
Activity		Set up Traffic measure according scenario (DRIP, TDI, speed limit advise, barrier cross etc.) Lead Road inspector related to DVM measures. Inform VCNL Log particularities and time of DVM measures	Support execution of DVM Measures	Manage damage recording and initiate repair. Audit official report.	Arrange Traffic Information	

Figure A1.4.1: Speed limits and Barrier Cross and DRIP (Source: RWS, 2000)

APPENDIX 1.5 (IM+) Divert Traffic

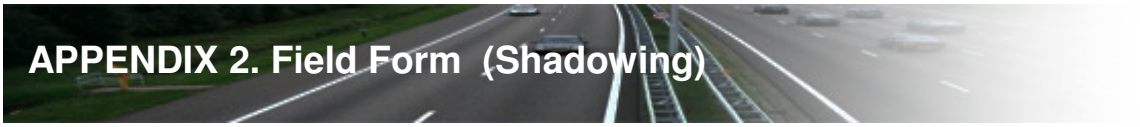
Organization Role	*Districts Coordinator*	*Highway Traffic Controller*	*Road inspector*	*National Highway Traffic Controller*	*KLPD / regional police force*
Task	Decide	Execute	Contribute	Contribute	Advise
Document	*RWS Agreement.*	*RWS Agreement.*	*Scenario Traffic Diversion.* *Protocol Traffic Diversion.*		*Guideline first safety-measures with incidents*
Systems	Logging				
Activity	Manage damage recording and initiate repair. Supervise official report.		Determine way of removal vehicle(s). Consult with CTPI. Execute Traffic Diversion conform *'Protocol Traffic Diversion'.* Inform VCNL Inform road-user with DRIP. Handles Traffic Information. Logging administration.		

APPENDIX 1.6 (IM+) Salvage and Repair

Organization Role	*Coordinating Highway Traffic Controller*	*Highway Traffic Controller*	*Road inspector*	*National Highway Traffic Controller*	*Travel Information Operator*	*Districts Coordinator*	*KLPD / regional police force*
Task	Decide	Advise	Execute	Receive Information	Receive Information	Advise	Advise
Document	*Agreement with contractor and vehicle recovery companies.*	*Agreement with contractor and vehicle recovery companies*	*Agreement with contractor and vehicle recovery companies*	*Calculation Traffic Congestion costs.* *Protocol*		*Agreement with contractor and vehicle recovery companies*	*Agreement with contractor and vehicle recovery companies*
Systems							
Activity		Inform VCNL. Monitor Traffic and manage time-window of measure. Log Motivation and communicat ion	Deliberate with CTPI about the way of removal vehicles. Obtain information of repair and congestion costs. Determine way of removal. Organise removal and repair. Log motivation and decision-making.		Attend Traffic Information		

APPENDIX 1.7 (IM+) End of Measure

Organization Role	Coordinating Highway Traffic Controller	Highway Traffic Controller	Road inspector	Districts Coordinator	KLPD / regional police force
Task	Decide	Advise	Execute	Advise	Advise
Document					
Systems	Logging				
Activity	Coordinate priorities deployment. Manage evaluation.	Deliberate with VCNL for ending the taken measure. Inform VCNL about end of measure.	Coordinate removal Textwagon and clear the road.		



APPENDIX 2. Field Form (Shadowing)

Shadowing Form

Clocktime road inspector		clocktime analist	

Date:		arrival time		depart time	

	rain	fog	heavily clouded	light clouded	sun
Weather	☐	☐	☐	☐	☐

	quit	onhearable
Noise	⊢	⊣

Activities Road Inspector

start trigger	

stop trigger	

Information used		Source

Equipment used	

Communication with whom and call-specifications

Who	callnr.	Mean of Communication	starttime	endtime

Callnr.	Call

Appendix 3.1 Cover Letter – English Version

Dear Colleague,

My name is Paul Jonk and I work as a Project Manager with the department of *User Support Geo-Applications* in the Dutch Ministry of Transportation, Public Works and Water Management (RWS). Currently, I am undertaking my Masters Degree at Manchester Metropolitan University where I am doing research into user acceptance by the Dutch Road inspectors of Location Services with Incident Management.

To obtain a better understanding of the Road inspector's judgement of innovative technology, like Location Services, your help is very important. With this letter I want to ask you if you could spend about 10 minutes of your time to fill in the enclosed Excel-Questionnaire.

The questions concern a relatively young information technology, called Location Services. In this questionnaire for this the abbreviation "*LS*" will be used.

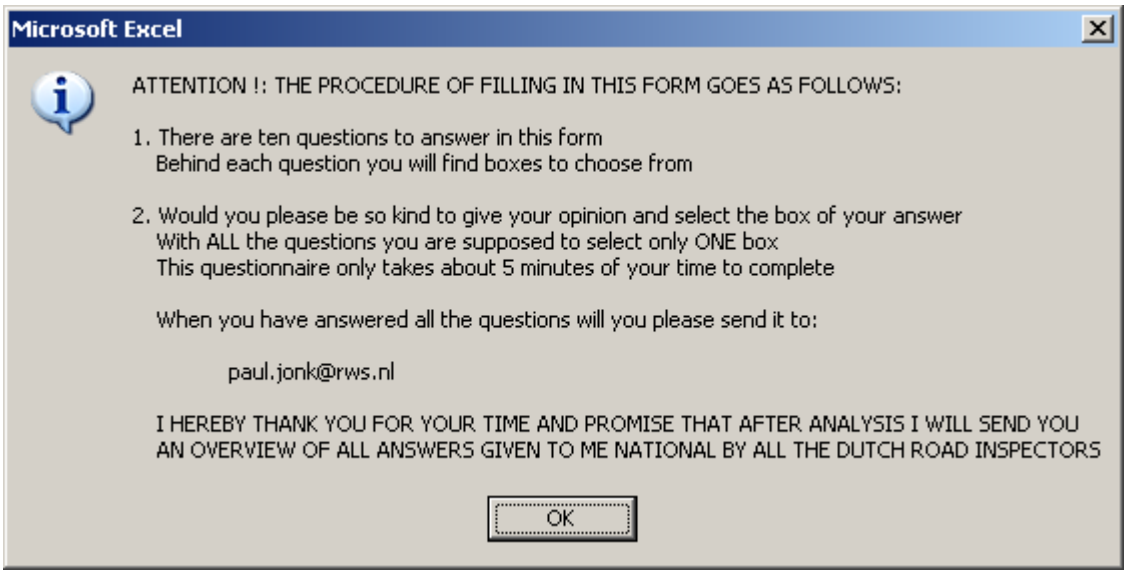
But first let me explain what Location Services could mean to you.

When you are working "in the field" with a mobile device (like a handheld or tablet PC) with Location Services you are able to get real-time information from a server at the office, without having to go to the office to synchronize that device. Also your 'field'-registration, like field-reports or pictures can be uploaded and be made real-time available for other emergency services like the Traffic Control Centre, Fire brigade, Police, Ambulance etc. With that real-time information these emergency services can make a better judgement of the incident and make a better consideration of the deployment of their resources. Also a diversity of information can be made available to you. For instance dynamic information, like traffic density of the surrounding highways or information of the location of your colleagues. Not only dynamic information, but also information like "Where is the nearest hospital?" or information of toxic or chemical truckloads and the necessary rescue procedures are on-line at your disposal. Perhaps you have ever been in a situation that you were not able to oversee the consequences of your actions. With Location services (LS) you can call for an expert's opinion at the office or call for assistance from a colleague nearby.

As you can see with LS a wide variety of information services can be made available to you. All these Information Services take your location into account (e.g. with Satellite navigation, GPS) so you can obtain information tailored to your situation and location.

I realize that because you had not have the opportunity yet to work with LS the following questions may seem rather theoretical. Still I hope that my explanation gives you a good idea of what LS could mean to you. When you are answering the questionnaire please keep this picture in mind.

When you start the Excel-file "*Questionnaire_road_inspector.xls*" you will see the next message box on your screen.



If this is not the case your safety settings are set to *average* or *high*. In that case the button at the end of the questionnaire is also disabled. You can send your completed questionnaire as an attachment to paul.jonk@rws.nl

I would be very grateful if you could you be so kind to fill in this questionnaire within the next two weeks. This gives me the opportunity to analyse your answers properly.

If you have any questions about the questionnaire or the research you can always call me (+31 (0)6-23498724 or (+31 (0)23-5364987).

I promise you that your answers will be dealt with confidentially and that I will inform you of the overall outcome of this research-project

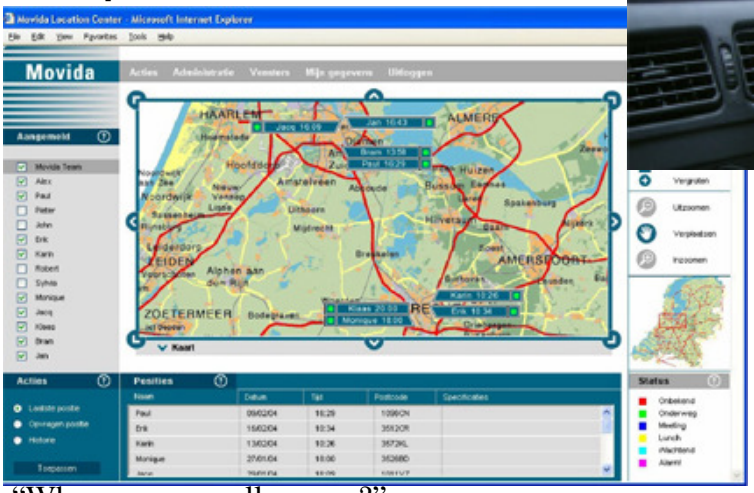
On the next page you can find some examples of location services.

Thank you in advance for your time and effort. Your assistance is of great help to me.

With the kindest regards,

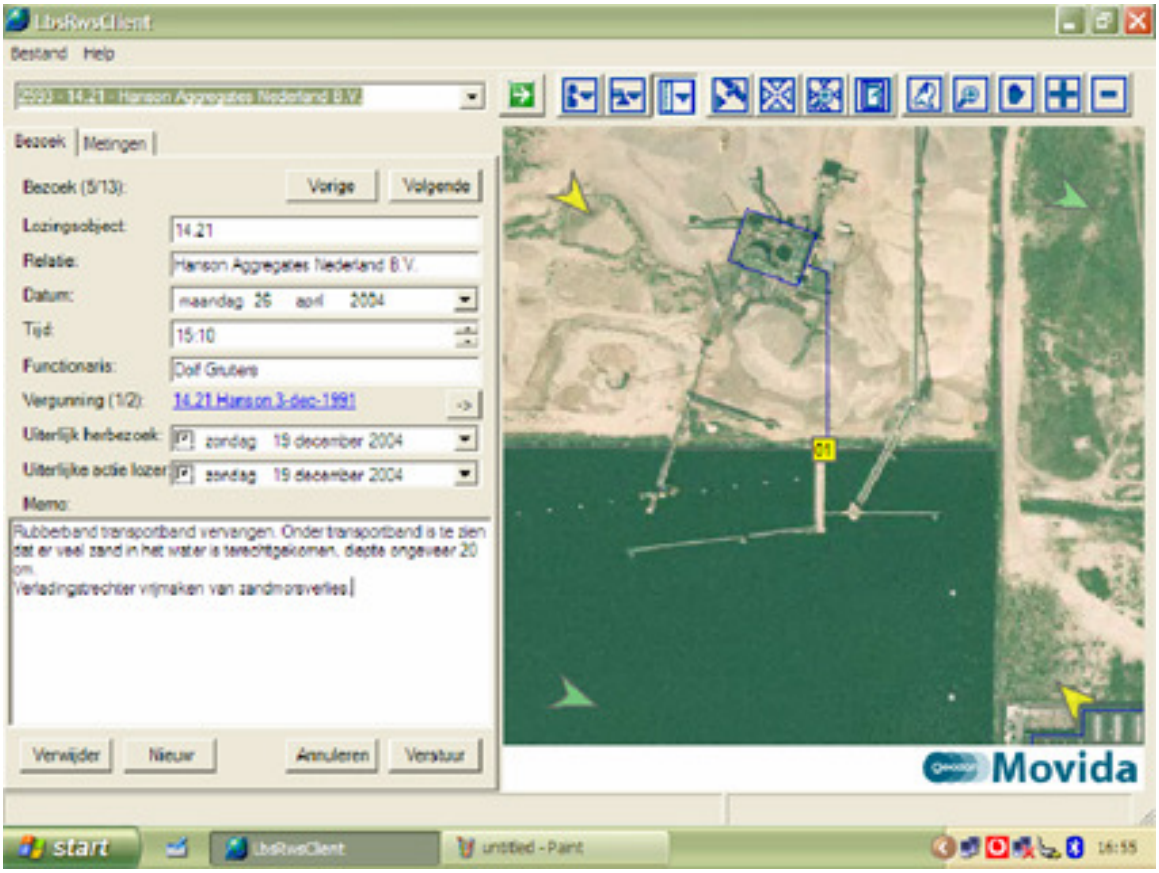
Paul Jonk
Project manager User Support Geo-Applications
telephone: +31 (0)6-23498724 or +31 (0)23-5364987
mailto: paul.jonk@rws.nl

Examples:



"Where are my colleagues ?"

Registration without LS ..and with LS



Left: On-Line information (with LS) **Right:** Connection with Mobile GIS

Appendix 3.2 Questionnaire – English Version

Questionnaire of users acceptance of Location Services

On behalf of statistics first you will be asked to fill in some questions in general

1. What is your age?

- ☐ till 19
- ☐ 20 - 24
- ☐ 25 - 29
- ☐ 30 - 34
- ☐ 35 - 39
- ☐ 40 - 44
- ☐ 45 - 49
- ☐ 50 - 54
- ☐ 55 - 59
- ☐ 60 and older

2. What is your gender?

- ☐ MALE
- ☐ FEMALE

3. What is your highest education?

- ☐ MIDDELBARE SCHOOL
- ☐ LBO
- ☐ MBO
- ☐ HBO
- ☐ WO

4a. At what district are you employed?

- ☐ ALKMAAR
- ☐ AMSTERDAM
- ☐ ARNHEM - NIJMEGEN
- ☐ BREDA
- ☐ DRENTHE
- ☐ EINDHOVEN
- ☐ FLEVOLAND EN AFSLUITDIJK
- ☐ FRIESLAND
- ☐ GRONINGEN
- ☐ HAAGLANDEN
- ☐ RIJNMOND
- ☐ S-HERTOGENBOSCH
- ☐ ST. JOOST
- ☐ TWENTE EN ACHTERHOEK
- ☐ UTRECHT
- ☐ VELUWE
- ☐ VENLO
- ☐ ZEELAND
- ☐ ZUID-HOLLANDSE WAARDEN
- ☐ ZWOLLE

4b. How long do you work as a road inspector?

- ☐ 0 - 5 years
- ☐ 6 - 10 years
- ☐ 11 - 15 years
- ☐ 16 - 20 years
- ☐ 21 - 25 years
- ☐ 25 - 30 years
- ☐ 31 - 35 years
- ☐ > 35 years

5. Do you expect that LS can be an added value in your workprocedures?

Please give your opinion about the theorem stated (per theorem only one answer, please)

Usefullness	totally agree	agree	neutral	disagree	totally disagree
LS can automatically generate my location and time. Therefore the usage of LS enables me to communicate my messages more quickly	☐	☐	☐	☐	☐
The surrounding area of an incident can be presented directly using LS. Therefore with LS I am able to make better decisions.	☐	☐	☐	☐	☐
LS can show me the exit routes when handling an incident. Therefore LS can be an added value with IM+	☐	☐	☐	☐	☐
Safety is an important issue when toxic or chemicals are involved. LS can inform me of the procedures to follow. Therefore LS would enhance my effectiveness on the job	☐	☐	☐	☐	☐
LS can provide my location and time of arrival at the scene of an incident.Therefore the usage of LS would make it easier to do my job	☐	☐	☐	☐	☐
Administration can be done 'in the field' and directly can be made available for the office. With LS I have less afterwork at the office.	☐	☐	☐	☐	☐
Different type of vehicles, like hybrids, have their own rescue specifications. LS can provide information of the vehicles in the field. Therefore with the usage of LS I am better informed.	☐	☐	☐	☐	☐
I expect that the usage LS as information service enables me to communicate better	☐	☐	☐	☐	☐
I expect that LS is an added value for my work	☐	☐	☐	☐	☐

6a. This question handles your opinion of ease of use

Please give your opinion about the theorem stated (per theorem only one answer, please)

Ease of Use	totally agree	agree	neutral	disagree	totally disagree
I expect that learning to operate the applications of LS would be easy to me	☐	☐	☐	☐	☐
I would find it easy to get the applications of LS to do what I want to do	☐	☐	☐	☐	☐
My interaction with the applications of LS would be clear and understandable	☐	☐	☐	☐	☐
I would find the applications of LS to be flexible to interact with	☐	☐	☐	☐	☐
For me it is important to be leaded step by step by the LS application	☐	☐	☐	☐	☐
I find it very important that the application of LS is easy to use	☐	☐	☐	☐	☐
I would find the applications of LS hard to understand	☐	☐	☐	☐	☐
I have difficulties in adopting innovative technology	☐	☐	☐	☐	☐

6b. What is more important to you, Ease of Use or Usefullness?

	Ease of Use	Usefullness	Doesn't matter
What is more important to you?	☐	☐	☐

7. This question handles your experience in working with automation, aswel as private as with your work.

Please give your opinion about the theorem stated (per theorem only one answer, please)

Experience	totally agree	agree	neutral	disagree	totally disagree
When determining my routes I often use route-navigation systems	☐	☐	☐	☐	☐
I prevere working with maps than written text	☐	☐	☐	☐	☐
I have no problem showing someone the way	☐	☐	☐	☐	☐
I think the usage of LS agrees with the way I prefer to work	☐	☐	☐	☐	☐
When LS becomes avaiable to me I am intent to use LS	☐	☐	☐	☐	☐

	daily	weekly	monthly	hardly ever	never
How often are you working at home using the computer (no games)?	☐	☐	☐	☐	☐
Do you already use a Web application (like InfraWEB) in your car during work?	☐	☐	☐	☐	☐
How often do you use the Internet for searching information?	☐	☐	☐	☐	☐

8. The next question concerns your appreciation of information and your interest in hardware aspects

Please give your opinion about the theorem stated (per theorem only one answer, please)

Information and technology	totally agree	agree	neutral	disagree	totally disagree
For me it is important to have the required information available promptly	☐	☐	☐	☐	☐
For me it is important that all the partners involved have the same information available.	☐	☐	☐	☐	☐
I don't mind to share my information with the IM+ partners (e.g. Police, Fire brigade, Ambulance, etc.).	☐	☐	☐	☐	☐
For me it is important to have a direct on-line connection.	☐	☐	☐	☐	☐
The screen must have a good readableness at all times.	☐	☐	☐	☐	☐
For me the dimension of the screen is important	☐	☐	☐	☐	☐
For me it is important to have the possibility of taking the device with me	☐	☐	☐	☐	☐
The mobile device must be waterproof.	☐	☐	☐	☐	☐

9. The nest question concerns your tasks with IM+ and the cooperation with the other partners.

Please give your opinion about the theorem stated (per theorem only one answer, please)

IM+ Tasks	daily	weekly	monthly	hardly ever	never
I am sceduled to work in shifts with IM+	☐	☐	☐	☐	☐
When you answered "never" you can skip the rest of question 9					

IM+ tasks and dependencies	totally agree	agree	neutral	disagree	totally disagree
With IM+ I cooperate with other partners (e.g. Police, Fire brigade, VCNL etc.)	☐	☐	☐	☐	☐
When carrying out my tasks with IM+ others are dependant on me	☐	☐	☐	☐	☐
When carrying out my tasks with IM+ I am dependant on others	☐	☐	☐	☐	☐
When carrying out my tasks with IM+ I take the decisions myself	☐	☐	☐	☐	☐
When carrying out my tasks with IM+ I am managed by others	☐	☐	☐	☐	☐
Without up-to-date information I can not do my work properly	☐	☐	☐	☐	☐
I am missing information to do my IM+ tasks properly	☐	☐	☐	☐	☐

Possible missing information can be filled in --->	

10. The last question concerns your location awareness and logistics

Please give your opinion about the theorem stated (per theorem only one answer, please)

Location awareness and logistics	totally agree	agree	neutral	disagree	totally disagree
I always know exactly where to find my resources	☐	☐	☐	☐	☐
By using LS as information service I have a better insight in the location of my resources	☐	☐	☐	☐	☐
By using LS as information service I can be better deployed	☐	☐	☐	☐	☐
I always know exactly the location of my partners	☐	☐	☐	☐	☐

I thank you for filling in this form. With this form you have given me more insight in what you think is important for implementing an innovative technology, like Location Services, for your work during incidents on the Dutch higways.

!!! To save and to send this form you can do this by pushing the button below.

Send this Form

Table A4.1: POC-User Interface

USER INTERFACE	motivation
Three obvious buttons: • *"In Place"*	When VC-NWN has sent a Road inspector to the location of an incident the registration time is started. Due to a service level agreement the Road inspector must be at the location within 15 minutes (guaranteed 80%). By using the "In place"-button the actual used time-stamp can automatically be generated. At this moment this is done by mobile phone.
• "*Man in Distress"*	The Road inspector mostly works alone. In case of emergency (e.g. aggression towards the Road inspector) the Road inspector can "ask" for assistance by pushing this button.
• *"Momentarily not Available"*	The Road inspector can be busy with other duties, so that he is not available at that time to assist with an accident. If this button is used the Traffic Control Centre is able to make a quick decision to sent another Road inspector to the location of the incident.
"Wizard"- like forms	To register the incidents the VC-WNW and the Road inspector of the district of Amsterdam use a Web application called "*InfraWEB*". (Figure A4.1). On the screen the Road inspector can choose several items to fill in. To prevent possible missing items the Road inspector wishes to be led by follow-up screens.
Readable size of fonts	Due to safe driving information must be readable for the Road inspector. (possible with voice)

Figure A4.1: Screenshots of InfraWEB

Table A4.2: POC-Information

INFORMATION (layers)	motivation
• *"procedures of handling incidents with toxic or chemical loads"*	Information request concerning the procedures to follow (e.g. distance, approach instructions etc) on behalf of safety.
• *"Operational Deployment Plan"* (on-line)	The operational Deployment Plan gives more insight is where the colleague Road inspectors are planned
• *"Vehicle rescue characteristics"*	With the introduction of hybrid cars it is not clear if the current rescue procedures are still valuable. With this information the Road inspector can make a better judgment of rescue measures.
• *"Surrounding Area and Objects"*	Better overview of actions to take (e.g. school nearby when incident with toxic fume occurs)
• *"Exit routes"*	On behalf of Traffic Diversion

Table A4.3: POC-Network

NETWORK	motivation
• *Private network*	In times of crisis (large scale of incident) often the GSM-network is out of reach or busy. The Road inspector needs to be able to stay in touch with the Traffic Control centre.
• *Faster network*	The upload and download time at this moment is insufficient.

Table A4.4: POC-Hardware

PHYSICAL ASPECTS	motivation
• *Adaptable Screen (light)*	Daytime and nighttime require a different exposure-setup
• *Readable screen at all times*	Sun reflection makes the current screen unreadable.

Appendix 5 Frequencies per Department

USEFULLNESS Question 5.1	Index of diversity: 0,785	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
The usage of LS enables me to communicate my messages more quickly	Totally Agree	0	2	2	1	4	2	7	3	**21**
	Agree	10	6	6	4	15	8	17	2	**68**
	Neutral	4	3	2	5	4	4	5	1	**28**
	Disagree	1	0	1	0	1	2	2	0	**7**
	Totally Disagree	0	0	0	0	2	0	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.2	Index of diversity: 0,823	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
With LS I am able to make better decisions.	Totally Agree	0	2	2	1	3	1	5	1	**15**
	Agree	8	6	5	5	14	7	14	3	**62**
	Neutral	4	3	3	4	7	4	7	2	**34**
	Disagree	3	0	1	0	1	4	5	0	**14**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.3	Index of diversity: 0,830	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
LS can be an added value with IM+	Totally Agree	1	2	2	2	4	1	6	3	**21**
	Agree	7	4	7	5	17	7	13	2	**62**
	Neutral	4	4	2	3	3	5	8	1	**30**
	Disagree	3	1	0	0	1	3	4	0	**12**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.4	Index of diversity: 0,811	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
LS would enhance my effectiveness on the job	Totally Agree	1	5	4	2	5	1	8	3	**29**
	Agree	7	4	6	5	15	10	13	3	**63**
	Neutral	6	2	1	3	5	4	6	0	**27**
	Disagree	1	0	0	0	0	1	4	0	**6**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.5	Index of diversity: 0,832	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
The usage of LS would make it easier to do my job	Totally Agree	4	4	7	2	8	1	13	3	**42**
	Agree	6	7	2	4	11	13	10	3	**56**
	Neutral	4	0	2	3	4	1	5	0	**19**
	Disagree	1	0	0	1	2	1	2	0	**7**
	Totally Disagree	0	0	0	0	1	0	1	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.6	Index of diversity: 0,802	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
With LS I have less afterwork at the office.	Totally Agree	2	1	5	1	4	2	4	2	**21**
	Agree	7	6	3	6	15	9	18	3	**67**
	Neutral	4	3	3	2	4	3	6	1	**26**
	Disagree	2	1	0	1	1	2	2	0	**9**
	Totally Disagree	0	0	0	0	2	0	1	0	**3**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.7	Index of diversity: 0,814	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
With the usage of LS I am better informed.	Totally Agree	1	1	3	2	1	1	5	1	**15**
	Agree	5	6	4	1	15	7	14	4	**56**
	Neutral	7	4	4	6	9	5	10	1	**46**
	Disagree	2	0	0	1	0	3	2	0	**8**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.8	Index of diversity: 0,822	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I expect that the usage LS as information service enables me to communicate better	Totally Agree	0	2	3	0	3	1	5	2	**16**
	Agree	8	4	3	4	11	5	10	3	**48**
	Neutral	5	5	5	5	11	9	12	1	**53**
	Disagree	2	0	0	1	0	1	4	0	**8**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

USEFULLNESS Question 5.9	Index of diversity: 0,733	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I expect that LS is an added value for my work	Totally Agree	1	2	3	1	3	1	4	3	**18**
	Agree	7	6	6	6	18	10	18	2	**73**
	Neutral	6	3	2	3	4	4	7	1	**30**
	Disagree	1	0	0	0	0	1	2	0	**4**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

EASE OF USE Question 6.1	Index of diversity: 0,789	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I expect that learning to operate the applications of LS would be easy to me	Totally Agree	0	2	2	0	5	0	8	2	**19**
	Agree	4	5	7	6	11	7	10	4	**54**
	Neutral	10	4	2	3	9	9	11	0	**48**
	Disagree	0	0	0	1	0	0	0	0	**1**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: *Agree*

EASE OF USE Question 6.2	Index of diversity: 0,838	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I would find it easy to get the applications of LS to do what I want to do	Totally Agree	1	1	4	0	3	0	6	2	**17**
	Agree	3	6	2	5	9	8	9	3	**45**
	Neutral	9	4	5	4	10	7	12	0	**51**
	Disagree	1	0	0	1	2	1	2	1	**8**
	Totally Disagree	0	0	0	0	2	0	0	0	**2**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: *Agree*

EASE OF USE Question 6.3	Index of diversity: 0,777	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
My interaction with the applications of LS would be clear and understandable	Totally Agree	0	1	4	0	2	0	4	2	**13**
	Agree	4	7	5	6	12	6	13	3	**56**
	Neutral	10	3	2	3	11	9	11	0	**49**
	Disagree	0	0	0	1	0	1	1	1	**4**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: *Agree*

EASE OF USE Question 6.4	Index of diversity: 0,824	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I would find the applications of LS to be flexible to interact with	Totally Agree	0	1	3	0	3	1	3	2	**13**
	Agree	5	4	3	6	9	5	14	3	**49**
	Neutral	9	5	5	3	10	9	9	0	**50**
	Disagree	0	1	0	1	2	1	3	1	**9**
	Totally Disagree	0	0	0	0	2	0	0	0	**2**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: *Agree*

EASE OF USE Question 6.5	Index of diversity: 0,835	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
For me it is important to be leaded step by step by the LS application	Totally Agree	2	1	3	4	4	1	3	3	**21**
	Agree	5	6	4	4	15	6	11	3	**54**
	Neutral	5	4	3	2	5	8	13	0	**40**
	Disagree	2	0	1	0	2	1	2	0	**8**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: *Agree*

EASE OF USE Question 6.6	Index of diversity: 0,760	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I find it very important that the application of LS is easy to use	Totally Agree	5	8	7	4	17	5	13	4	**63**
	Agree	3	3	4	5	4	9	10	2	**40**
	Neutral	5	0	0	1	5	2	6	0	**19**
	Disagree	1	0	0	0	0	0	0	0	**1**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: Totally *Agree*

EASE OF USE Question 6.7	Index of diversity: 0,884	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I would find the applications of LS hard to understand	Totally Agree	0	0	1	0	0	0	0	1	**2**
	Agree	1	1	0	2	2	2	1	1	**10**
	Neutral	9	3	2	3	10	8	10	0	**45**
	Disagree	2	3	4	5	9	5	10	3	**41**
	Totally Disagree	2	4	4	0	5	1	8	1	**25**
	Total	**14**	**11**	**11**	**10**	**26**	**16**	**29**	**6**	**123**

Median: Disa*gree*

EASE OF USE Question 6.8	Index of diversity: 0,866	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I have difficulties in adopting innovative technology	Totally Agree	0	0	0	0	2	0	0	0	**2**
	Agree	0	2	0	2	0	1	0	0	**5**
	Neutral	6	2	2	2	5	6	8	0	**31**
	Disagree	5	2	4	5	12	7	8	4	**47**
	Totally Disagree	3	5	4	1	7	2	13	2	**37**
	Total	**14**	**11**	**10**	**10**	**26**	**16**	**29**	**6**	**122**

Median: Disa*gree*

USEFULLNESS vs. EoU Question 6b		Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
What is more important to you?	Usefullness	4	4	4	2	12	3	9	2	**40**
	Ease Of Use	7	6	5	4	9	3	15	2	**51**
	Neutral	2	1	2	3	6	9	7	2	**32**
	Total	**13**	**11**	**11**	**9**	**27**	**15**	**31**	**6**	**123**

Median: Ease of Use

EXPERIENCE Question 7.1	Index of diversity: 0,939	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
When determining my routes I often use route-navigation systems	Totally Agree	1	1	0	0	2	0	1	0	**5**
	Agree	2	1	0	3	5	2	6	2	**21**
	Neutral	4	1	1	1	5	3	7	1	**23**
	Disagree	4	3	5	5	8	5	9	1	**40**
	Totally Disagree	4	5	5	1	6	5	8	2	**36**
	Total	**15**	**11**	**11**	**10**	**26**	**15**	**31**	**6**	**125**

Median: Disa*gree*

EXPERIENCE Question 7.2	Index of diversity: 0,885	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I prefer working with maps than written text	Totally Agree	2	0	0	0	6	0	1	1	**10**
	Agree	3	2	3	2	3	3	13	4	**33**
	Neutral	7	4	3	7	11	8	12	1	**53**
	Disagree	3	5	3	1	3	3	5	0	**23**
	Totally Disagree	0	0	2	0	3	1	0	0	**6**
	Total	**15**	**11**	**11**	**10**	**26**	**15**	**31**	**6**	**125**

Median: Neutral

EXPERIENCE Question 7.3	Index of diversity: 0,724	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I have no problem showing someone the way	Totally Agree	4	3	0	0	9	1	9	0	**26**
	Agree	7	5	8	9	13	10	18	5	**75**
	Neutral	2	0	3	1	2	3	2	1	**14**
	Disagree	2	2	0	0	2	1	2	0	**9**
	Totally Disagree	0	1	0	0	0	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**15**	**31**	**6**	**125**

Median: *Agree*

EXPERIENCE Question 7.4	Index of diversity: 0,913	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I think the usage of LS agrees with the way I prefer to work	Totally Agree	0	3	1	0	4	0	3	1	**12**
	Agree	3	4	7	2	10	3	10	3	**42**
	Neutral	9	3	1	0	8	11	9	2	**43**
	Disagree	2	1	2	5	1	1	5	0	**17**
	Totally Disagree	1	0	0	3	3	0	3	0	**10**
	Total	**15**	**11**	**11**	**10**	**26**	**15**	**30**	**6**	**124**

Median: Neutral

INTENTION TO USE Question 7.5	Index of diversity: 0,770	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
When LS becomes available to me I am intent to use LS	Totally Agree	0	3	2	1	6	1	4	1	**18**
	Agree	7	4	6	7	15	6	19	4	**68**
	Neutral	7	4	2	1	3	8	7	0	**32**
	Disagree	1	0	0	1	1	0	1	1	**5**
	Totally Disagree	0	0	1	0	1	0	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**15**	**31**	**6**	**125**

Median: *Agree*

IT-EXPERIENCE Question 7.6	Index of diversity: 0,798	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
How often are you working at home using the computer (no games)?	Daily	8	6	7	4	9	9	16	3	**62**
	Weekly	1	4	2	3	11	3	9	1	**34**
	Monthly	0	1	1	0	2	2	1	0	**7**
	Hardly ever	2	0	1	2	0	0	1	0	**6**
	Never	1	0	0	0	4	1	4	1	**11**
	Total	**12**	**11**	**11**	**9**	**26**	**15**	**31**	**5**	**120**

Median: Daily

IT-EXPERIENCE Question 7.7	Index of diversity: 0,909	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
Do you already use a Web application in your car during work?	Daily	4	7	5	1	6	6	9	3	**41**
	Weekly	5	2	4	3	5	6	13	2	**40**
	Monthly	0	1	1	1	4	1	4	0	**12**
	Hardly ever	1	1	1	3	5	2	2	0	**15**
	Never	2	0	0	1	3	0	3	0	**9**
	Total	**12**	**11**	**11**	**9**	**23**	**15**	**31**	**5**	**117**

Median: Weekly

IT-EXPERIENCE Question 7.8	Index of diversity: 0,909	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
How often do you use the Internet for searching information?	Daily	1	0	7	2	9	1	10	0	**30**
	Weekly	4	0	2	3	9	1	3	0	**22**
	Monthly	1	1	0	3	0	1	1	0	**7**
	Hardly ever	0	1	1	0	3	3	3	0	**11**
	Never	6	9	1	0	2	9	14	5	**46**
	Total	**12**	**11**	**11**	**8**	**23**	**15**	**31**	**5**	**116**

Median: Monthly

INFORMATION DEPENDANCY Question 8.1	Index of diversity: 0,725	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
For me it is important to have the required information available promptly	Totally Agree	5	5	7	3	10	4	13	4	**51**
	Agree	7	6	2	7	12	11	16	2	**63**
	Neutral	3	0	1	0	3	1	2	0	**10**
	Disagree	0	0	1	0	1	0	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

INFORMATION DEPENDANCY Question 8.2	Index of diversity: 0,761	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
For me it is important that all the partners involved have the same information available.	Totally Agree	4	5	5	3	11	2	14	4	**48**
	Agree	8	6	5	6	12	11	11	2	**61**
	Neutral	3	0	1	1	3	3	2	0	**13**
	Disagree	0	0	0	0	0	0	4	0	**4**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

INFORMATION DEPENDANCY Question 8.3	Index of diversity: 0,748	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I don't mind to share my information with the IM+ partners	Totally Agree	2	2	2	0	6	1	7	2	**22**
	Agree	9	4	7	8	13	8	21	3	**73**
	Neutral	4	3	1	2	7	4	2	0	**23**
	Disagree	0	2	0	0	0	2	0	1	**5**
	Totally Disagree	0	0	1	0	0	1	1	0	**3**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

INFORMATION DEPENDANCY Question 8.4	Index of diversity: 0,786	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
For me it is important to have a direct on-line connection.	Totally Agree	4	2	5	2	9	3	13	3	**41**
	Agree	8	8	5	6	9	9	13	3	**61**
	Neutral	3	1	1	2	8	4	3	0	**22**
	Disagree	0	0	0	0	0	0	2	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

PHYSICAL ASPECTS Question 8.5	Index of diversity: 0,694	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
The screen must have a good readability at all times.	Totally Agree	7	7	7	3	11	6	20	3	**64**
	Agree	6	4	4	6	12	9	10	3	**54**
	Neutral	2	0	0	1	3	0	1	0	**7**
	Disagree	0	0	0	0	0	1	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: Totally *Agree*

PHYSICAL ASPECTS Question 8.6	Index of diversity: 0,838	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
For me the dimension of the screen is important	Totally Agree	4	5	7	3	12	4	15	1	**51**
	Agree	5	5	4	4	7	7	8	4	**44**
	Neutral	3	0	0	3	8	5	6	1	**26**
	Disagree	1	1	0	0	0	0	2	0	**4**
	Total	**13**	**11**	**11**	**10**	**27**	**16**	**31**	**6**	**125**

Median: *Agree*

PHYSICAL ASPECTS Question 8.7	Index of diversity: 0,894	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
For me it is important to have the possibility of taking the device with me	Totally Agree	3	4	2	2	3	2	9	1	**26**
	Agree	4	4	3	6	7	8	8	3	**43**
	Neutral	6	1	4	2	12	4	12	2	**43**
	Disagree	2	1	2	0	4	1	2	0	**12**
	Totally Disagree	0	1	0	0	0	1	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

PHYSICAL ASPECTS Question 8.8	Index of diversity: 0,860	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
The mobile device must be waterproof.	Totally Agree	5	2	3	4	5	2	13	2	**36**
	Agree	4	7	3	5	8	11	10	4	**52**
	Neutral	6	1	2	1	9	3	8	0	**30**
	Disagree	0	0	3	0	4	0	0	0	**7**
	Totally Disagree	0	1	0	0	0	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

INFORMATION DEPENDANCY Question 9.2	Index of diversity: 0,512	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
With IM+ I cooperate with other partners	Totally Agree	12	9	10	5	15	13	23	4	**91**
	Agree	2	2	1	5	11	3	7	2	**33**
	Neutral	1	0	0	0	0	0	1	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: Totally *Agree*

INFORMATION DEPENDANCY Question 9.3	Index of diversity: 0,769	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
When carrying out my tasks with IM+ others are dependant on me	Totally Agree	7	3	4	1	7	3	6	3	**34**
	Agree	6	7	5	8	11	9	20	2	**68**
	Neutral	2	1	1	1	4	3	4	1	**17**
	Disagree	0	0	1	0	3	1	1	0	**6**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

TASK DEPENDANCY Question 9.4	Index of diversity: 0,747	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
When carrying out my tasks with IM+ I am dependant on others	Totally Agree	7	3	3	0	5	2	8	3	**31**
	Agree	6	7	6	9	14	10	17	2	**71**
	Neutral	2	1	2	1	4	3	5	1	**19**
	Disagree	0	0	0	0	3	1	1	0	**5**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

TASK DEPENDANCY Question 9.5	Index of diversity: 0,663	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
When carrying out my tasks with IM+ I take the decisions myself	Totally Agree	5	4	4	2	7	4	12	4	**42**
	Agree	7	7	6	8	18	10	17	2	**75**
	Neutral	3	0	1	0	1	2	1	0	**8**
	Disagree	0	0	0	0	0	0	1	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

TASK DEPENDANCY Question 9.6	Index of diversity: 0,819	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
When carrying out my tasks with IM+ I am managed by others	Totally Agree	2	1	0	0	2	2	1	3	**11**
	Agree	4	6	6	3	11	8	13	2	**53**
	Neutral	7	3	3	5	10	6	14	1	**49**
	Disagree	2	0	2	2	3	0	3	0	**12**
	Totally Disagree	0	1	0	0	0	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

INFORMATION DEPENDANCY Question 9.7	Index of diversity: 0,848	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
Without up-to-date information I can not do my work properly	Totally Agree	4	1	2	0	1	1	7	3	**19**
	Agree	5	7	5	5	13	9	11	2	**57**
	Neutral	3	2	4	3	9	6	9	1	**37**
	Disagree	2	1	0	1	3	0	4	0	**11**
	Totally Disagree	1	0	0	1	0	0	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: *Agree*

INFORMATION DEPENDANCY Question 9.8	Index of diversity: 0,796	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I am missing information to do my IM+ tasks properly	Totally Agree	1	1	1	0	0	0	0	0	**3**
	Agree	3	0	2	1	5	3	7	1	**22**
	Neutral	6	5	5	4	16	8	16	3	**63**
	Disagree	3	5	3	5	5	5	8	2	**36**
	Totally Disagree	2	0	0	0	0	0	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**26**	**16**	**31**	**6**	**126**

Median: Neutral

LOCATION AWARENESS Question 10.1	Index of diversity: 0,762	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I always know exactly where to find my resources	Totally Agree	2	0	2	0	4	1	4	4	**17**
	Agree	9	7	7	6	15	9	18	2	**73**
	Neutral	3	0	1	4	4	2	8	0	**22**
	Disagree	1	4	1	0	3	4	1	0	**14**
	Totally Disagree	0	0	0	0	1	0	0	0	**1**
	Total	**15**	**11**	**11**	**10**	**27**	**16**	**31**	**6**	**127**

Median: *Agree*

LOCATION AWARENESS Question 10.2	Index of diversity: 0,828	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
By using LS as information service I have a better insight in the location of my resources	Totally Agree	0	0	0	0	0	0	1	0	**1**
	Agree	3	3	2	4	1	2	1	0	**16**
	Neutral	5	1	4	2	11	5	6	2	**36**
	Disagree	5	6	4	4	13	8	18	3	**61**
	Totally Disagree	2	1	1	0	2	1	5	1	**13**
	Total	**15**	**11**	**11**	**10**	**27**	**16**	**31**	**6**	**127**

Median: Dis*agree*

LOCATION AWARENESS Question 10.3	Index of diversity: 0,831	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
By using LS as information service I can be better deployed	Totally Agree	0	1	1	0	1	0	3	2	**8**
	Agree	5	4	4	5	12	4	8	1	**43**
	Neutral	9	5	2	5	11	10	13	2	**57**
	Disagree	1	1	4	0	1	2	5	1	**15**
	Totally Disagree	0	0	0	0	2	0	2	0	**4**
	Total	**15**	**11**	**11**	**10**	**27**	**16**	**31**	**6**	**127**

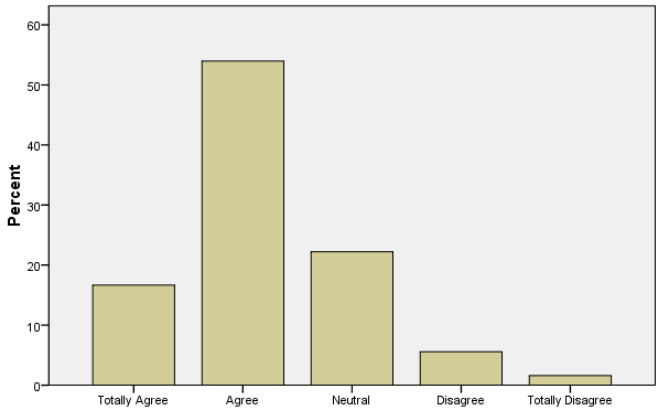
Median: Neutral

LOCATION AWARENESS Question 10.4	Index of diversity: 0,790	Department								
		lb	nb	nh	nn	on	ut	zh	zl	Total
I always know exactly the location of my partners	Totally Agree	0	1	1	1	4	1	6	3	**17**
	Agree	6	7	7	5	14	7	15	3	**64**
	Neutral	8	3	2	4	8	6	8	0	**39**
	Disagree	0	0	1	0	0	2	2	0	**5**
	Totally Disagree	1	0	0	0	1	0	0	0	**2**
	Total	**15**	**11**	**11**	**10**	**27**	**16**	**31**	**6**	**127**

Median: *Agree*

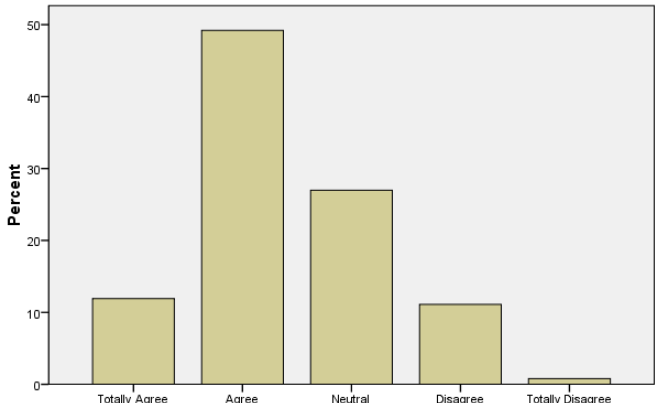
Appendix 6 Percentages per question

The usage of LS enables me to communicate my messages more quickly



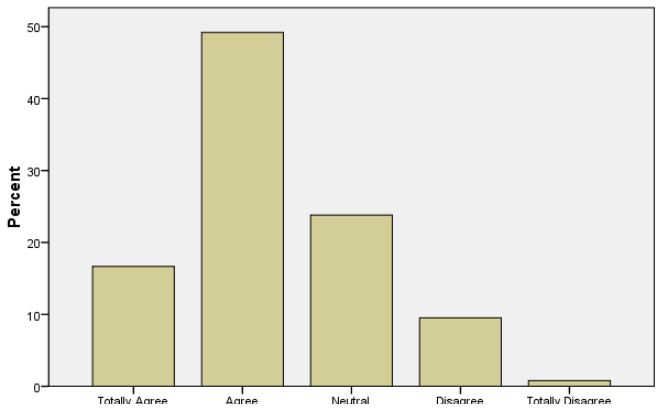
		Frequency	Percent
Valid	Totally Agree	21	16,5
	Agree	68	53,5
	Neutral	28	22,0
	Disagree	7	5,5
	Totally Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

With LS I am able to make better decisions.



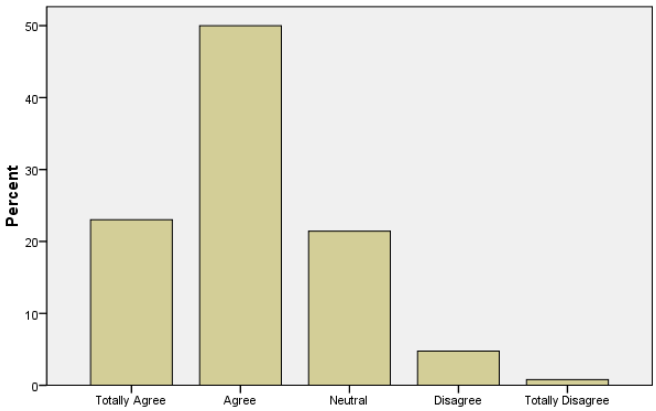
		Frequency	Percent
Valid	Totally Agree	15	11,8
	Agree	62	48,8
	Neutral	34	26,8
	Disagree	14	11,0
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

LS can be an added value with IM+



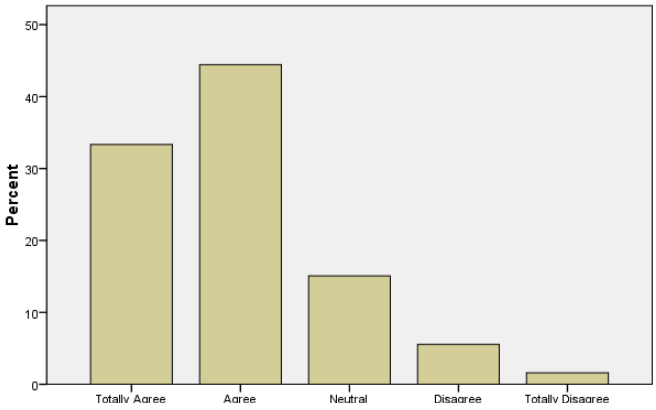
		Frequency	Percent
Valid	Totally Agree	21	16,5
	Agree	62	48,8
	Neutral	30	23,6
	Disagree	12	9,4
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

LS would enhance my effectiveness on the job



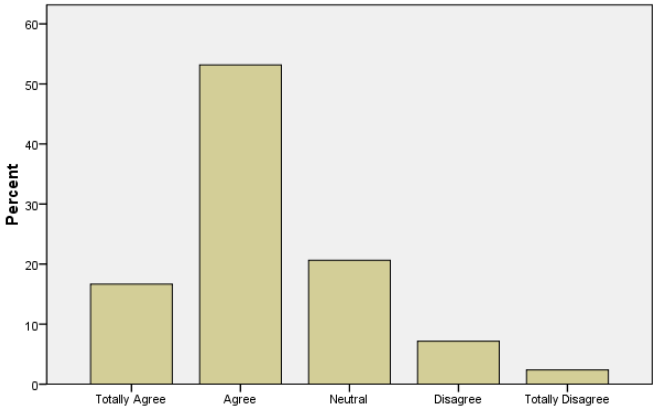
		Frequency	Percent
Valid	Totally Agree	29	22,8
	Agree	63	49,6
	Neutral	27	21,3
	Disagree	6	4,7
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

The usage of LS would make it easier to do my job



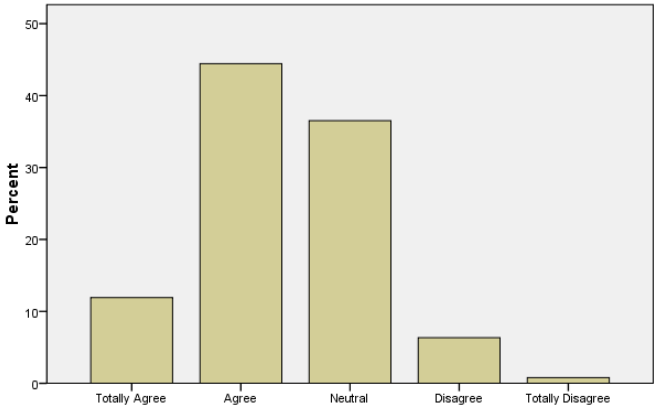
		Frequency	Percent
Valid	Totally Agree	42	33,1
	Agree	56	44,1
	Neutral	19	15,0
	Disagree	7	5,5
	Totally Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

With LS I have less afterwork at the office.



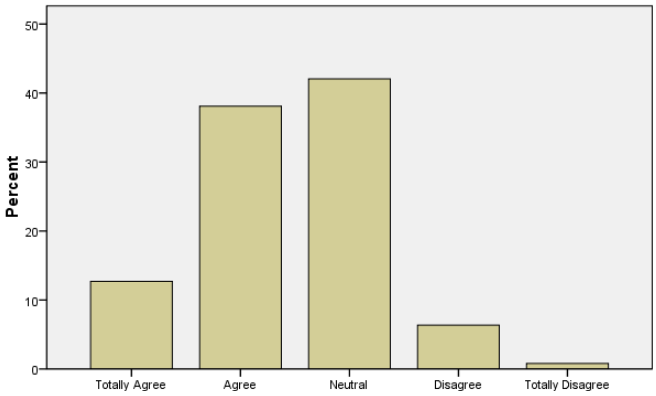
		Frequency	Percent
Valid	Totally Agree	21	16,5
	Agree	67	52,8
	Neutral	26	20,5
	Disagree	9	7,1
	Totally Disagree	3	2,4
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

With the usage of LS I am better informed.



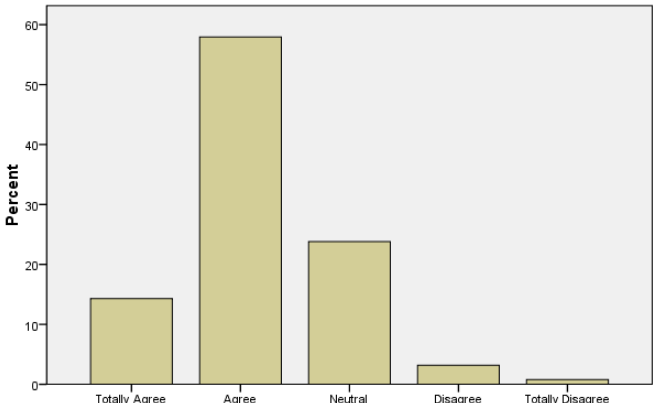
		Frequency	Percent
Valid	Totally Agree	15	11,8
	Agree	56	44,1
	Neutral	46	36,2
	Disagree	8	6,3
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

I expect that the usage LS as information service enables me to communicate better



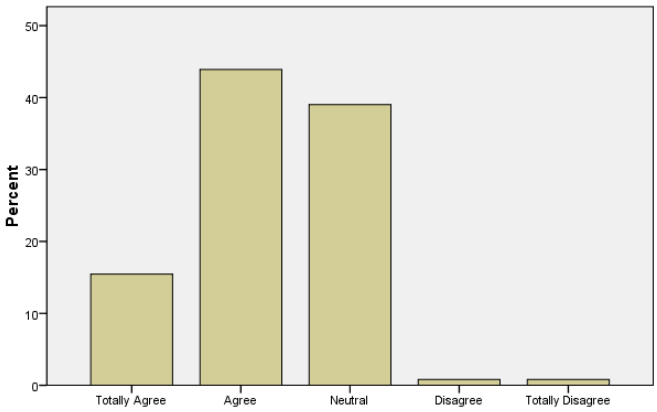
		Frequency	Percent
Valid	Totally Agree	16	12,6
	Agree	48	37,8
	Neutral	53	41,7
	Disagree	8	6,3
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

I expect that LS is an added value for my work



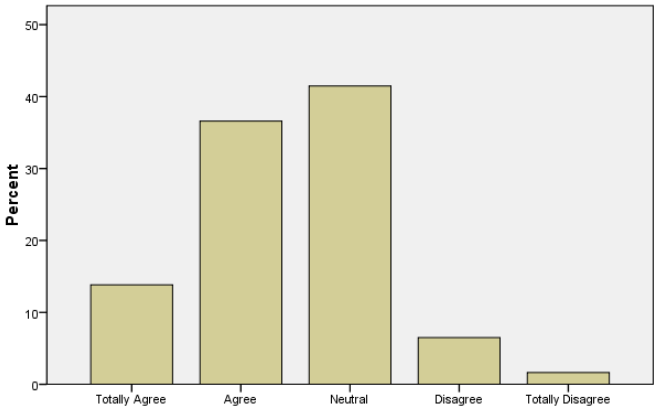
		Frequency	Percent
Valid	Totally Agree	18	14,2
	Agree	73	57,5
	Neutral	30	23,6
	Disagree	4	3,1
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

I expect that learning to operate the applications of LS would be easy to me



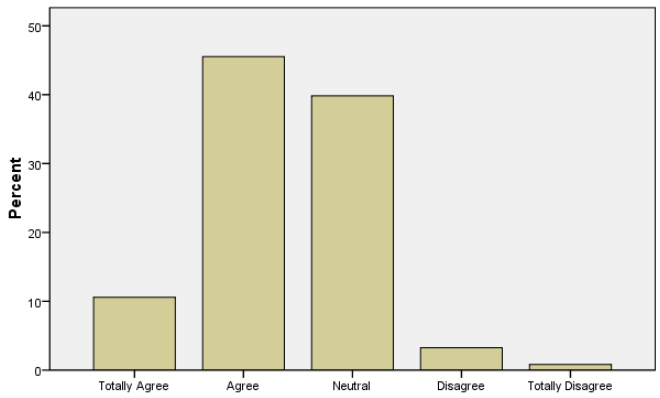
		Frequency	Percent
Valid	Totally Agree	19	15,0
	Agree	54	42,5
	Neutral	48	37,8
	Disagree	1	,8
	Totally Disagree	1	,8
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

I would find it easy to get the applications of LS to do what I want to do



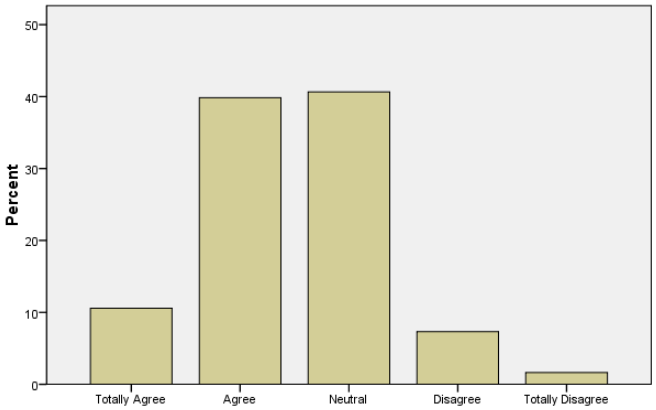
		Frequency	Percent
Valid	Totally Agree	17	13,4
	Agree	45	35,4
	Neutral	51	40,2
	Disagree	8	6,3
	Totally Disagree	2	1,6
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

My interaction with the applications of LS would be clear and understandable



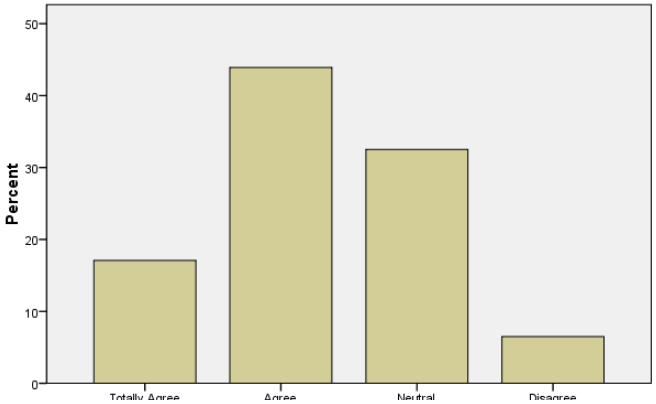
		Frequency	Percent
Valid	Totally Agree	13	10,2
	Agree	56	44,1
	Neutral	49	38,6
	Disagree	4	3,1
	Totally Disagree	1	,8
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

I would find the applications of LS to be flexible to interact with



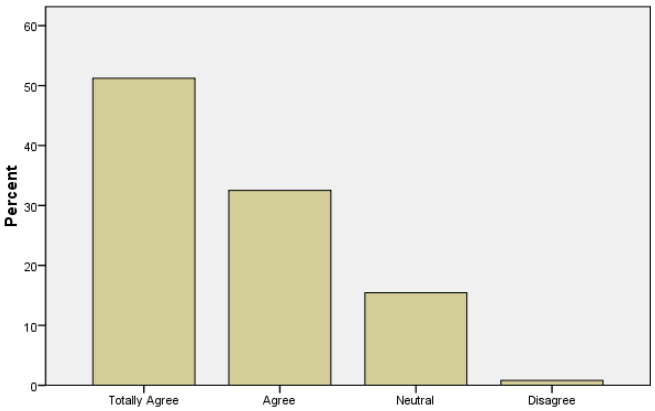
		Frequency	Percent
Valid	Totally Agree	13	10,2
	Agree	49	38,6
	Neutral	50	39,4
	Disagree	9	7,1
	Totally Disagree	2	1,6
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

For me it is important to be leaded step by step by the LS application



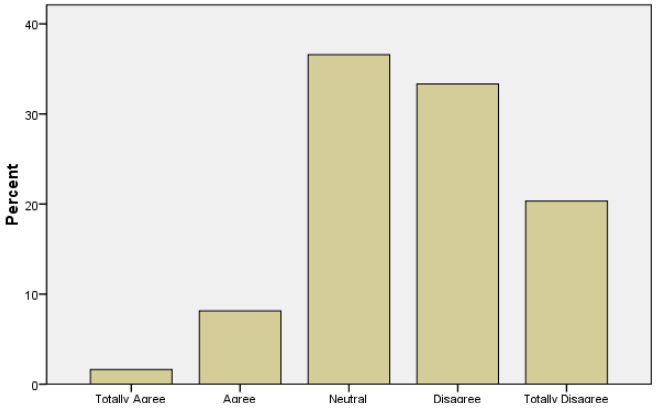
		Frequency	Percent
Valid	Totally Agree	21	16,5
	Agree	54	42,5
	Neutral	40	31,5
	Disagree	8	6,3
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

I find it very important that the application of LS is easy to use



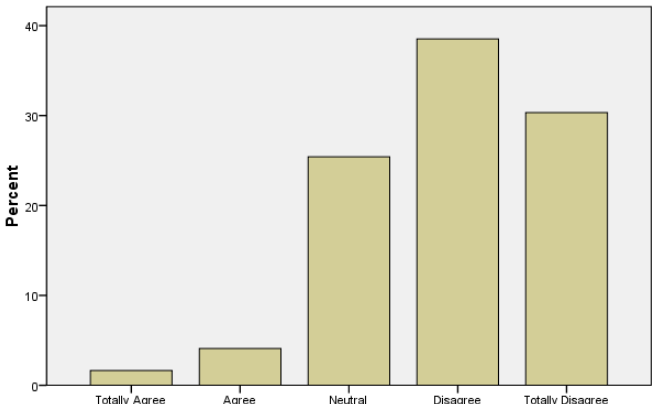
		Frequency	Percent
Valid	Totally Agree	63	49,6
	Agree	40	31,5
	Neutral	19	15,0
	Disagree	1	,8
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

I would find the applications of LS hard to understand



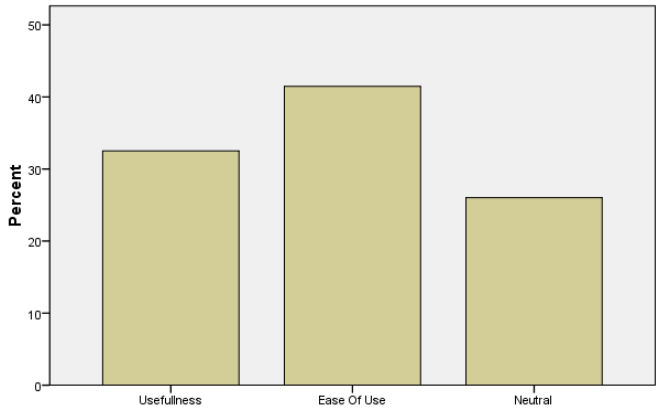
		Frequency	Percent
Valid	Totally Agree	2	1,6
	Agree	10	7,9
	Neutral	45	35,4
	Disagree	41	32,3
	Totally Disagree	25	19,7
	Total	123	96,9
Missing	99	4	3,1
Total		127	100,0

I have difficulties in adopting innovative technology



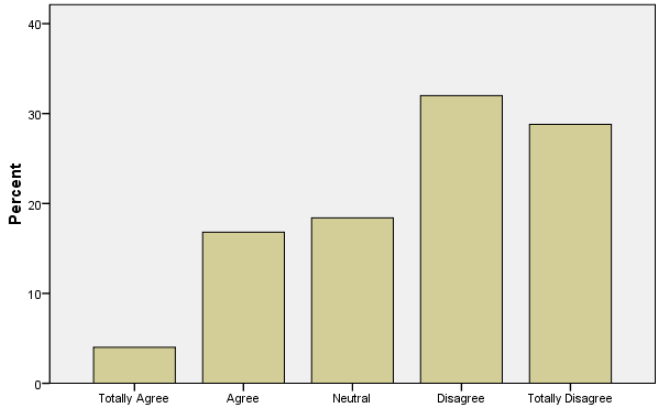
		Frequency	Percent
Valid	Totally Agree	2	1,6
	Agree	5	3,9
	Neutral	31	24,4
	Disagree	47	37,0
	Totally Disagree	37	29,1
	Total	122	96,1
Missing	99	5	3,9
Total		127	100,0

What is more important to you?



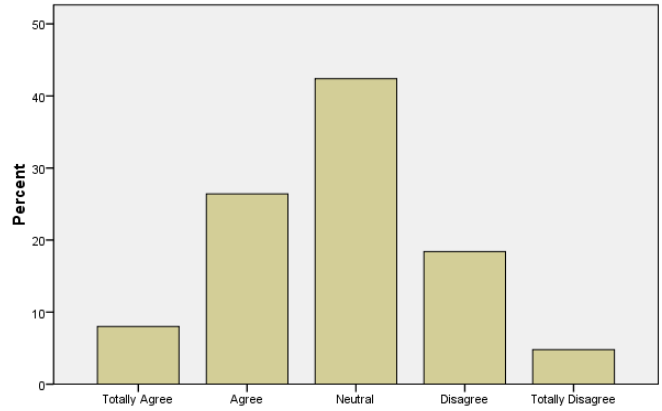
		Frequency	Percent
Valid	Usefullness	40	31,5
	Ease Of Use	51	40,2
	Neutral	32	25,2
	Total	123	96,9
Missing	99	3	2,4
	System	1	,8
	Total	4	3,1
Total		127	100,0

When determining my routes I often use route-navigation systems



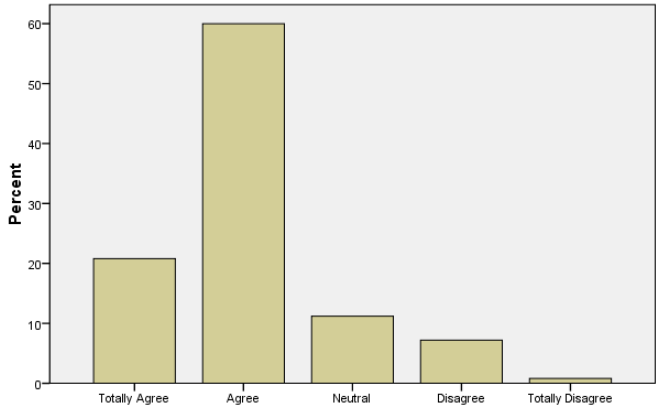
		Frequency	Percent
Valid	Totally Agree	5	3,9
	Agree	21	16,5
	Neutral	23	18,1
	Disagree	40	31,5
	Totally Disagree	36	28,3
	Total	125	98,4
Missing	99	2	1,6
Total		127	100,0

I prevere working with maps than written text



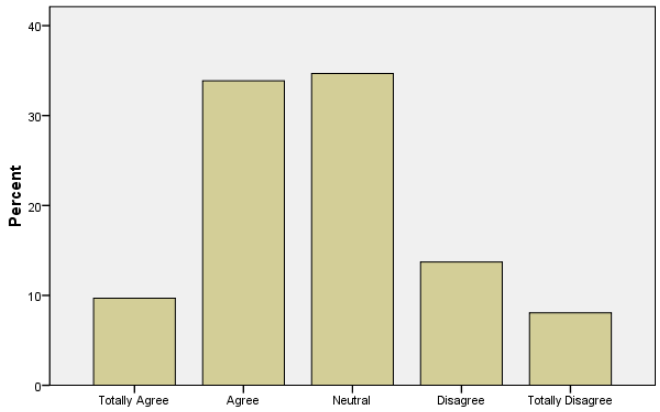
		Frequency	Percent
Valid	Totally Agree	10	7,9
	Agree	33	26,0
	Neutral	53	41,7
	Disagree	23	18,1
	Totally Disagree	6	4,7
	Total	125	98,4
Missing	99	2	1,6
Total		127	100,0

I have no problem showing someone the way



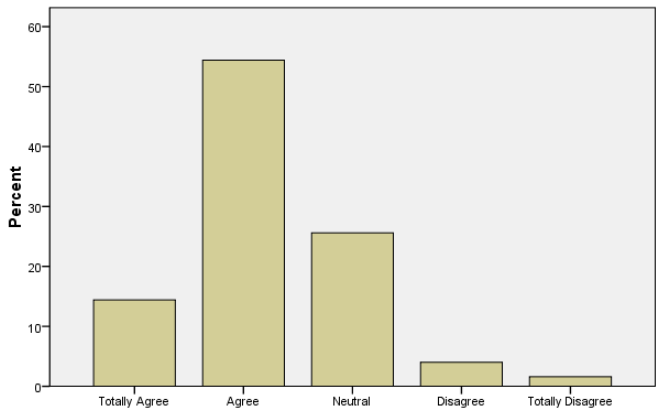
		Frequency	Percent
Valid	Totally Agree	26	20,5
	Agree	75	59,1
	Neutral	14	11,0
	Disagree	9	7,1
	Totally Disagree	1	,8
	Total	125	98,4
Missing	99	2	1,6
Total		127	100,0

I think the usage of LS agrees with the way I prefer to work



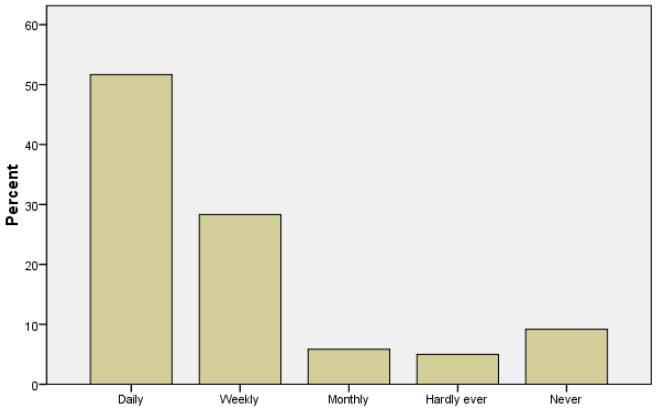
		Frequency	Percent
Valid	Totally Agree	12	9,4
	Agree	42	33,1
	Neutral	43	33,9
	Disagree	17	13,4
	Totally Disagree	10	7,9
	Total	124	97,6
Missing	99	3	2,4
Total		127	100,0

When LS becomes available to me I am intent to use LS



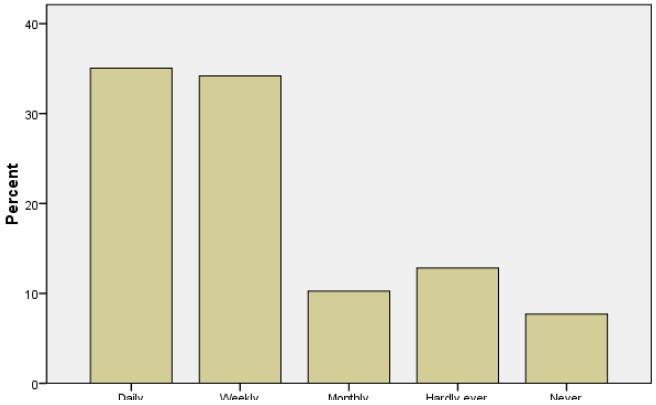
		Frequency	Percent
Valid	Totally Agree	18	14,2
	Agree	68	53,5
	Neutral	32	25,2
	Disagree	5	3,9
	Totally Disagree	2	1,6
	Total	125	98,4
Missing	99	2	1,6
Total		127	100,0

How often are you working at home using the computer (no games)?



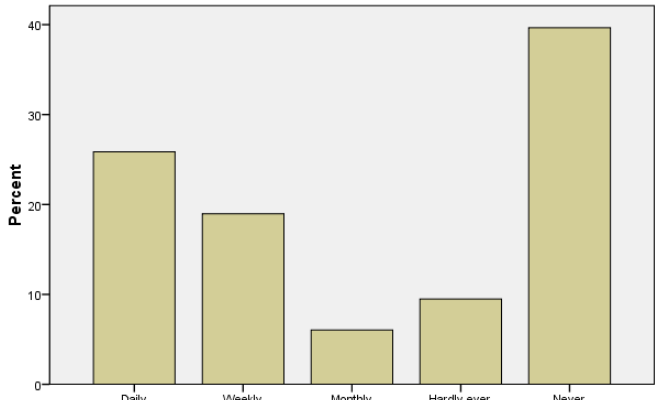
		Frequency	Percent
Valid	Daily	62	48,8
	Weekly	34	26,8
	Monthly	7	5,5
	Hardly ever	6	4,7
	Never	11	8,7
	Total	120	94,5
Missing	99	7	5,5
Total		127	100,0

Do you already use a Web application in your car during work?



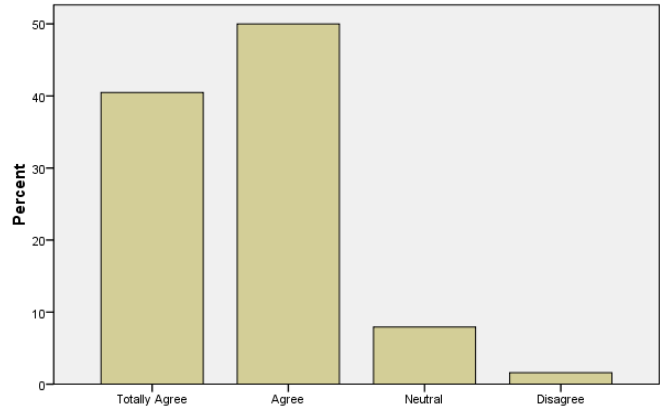
		Frequency	Percent
Valid	Daily	41	32,3
	Weekly	40	31,5
	Monthly	12	9,4
	Hardly ever	15	11,8
	Never	9	7,1
	Total	117	92,1
Missing	99	10	7,9
Total		127	100,0

How often do you use the Internet for searching information?



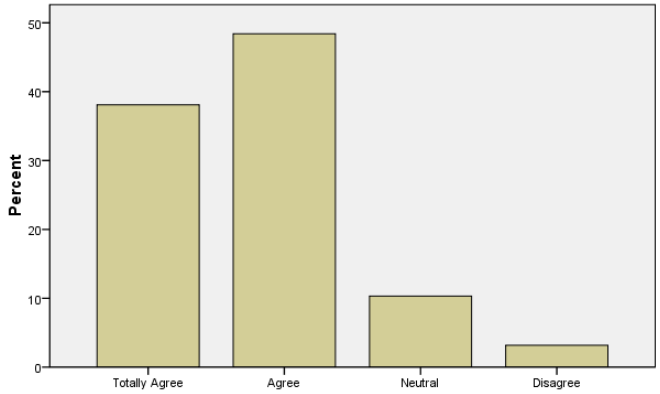
		Frequency	Percent
Valid	Daily	30	23,6
	Weekly	22	17,3
	Monthly	7	5,5
	Hardly ever	11	8,7
	Never	46	36,2
	Total	116	91,3
Missing	99	11	8,7
Total		127	100,0

For me it is important to have the required information available promptly



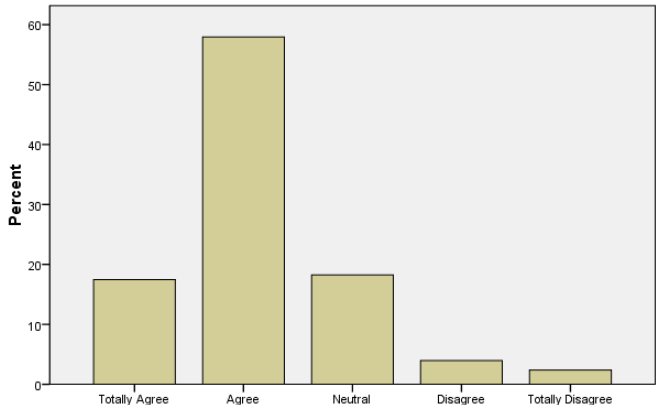
		Frequency	Percent
Valid	Totally Agree	51	40,2
	Agree	63	49,6
	Neutral	10	7,9
	Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

For me it is important that all the partners involved have the same information available.



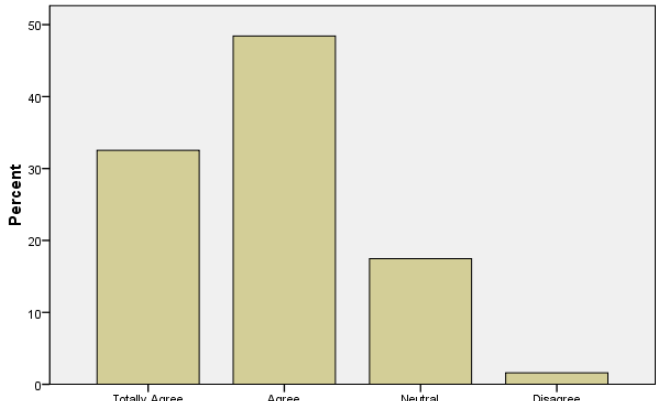
		Frequency	Percent
Valid	Totally Agree	48	37,8
	Agree	61	48,0
	Neutral	13	10,2
	Disagree	4	3,1
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

I don't mind to share my information with the IM+ partners



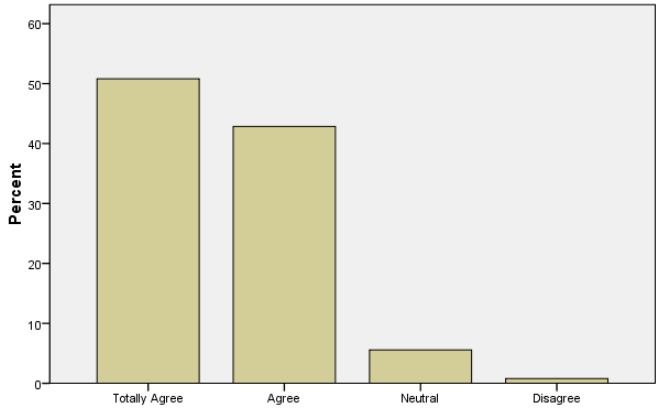
		Frequency	Percent
Valid	Totally Agree	22	17,3
	Agree	73	57,5
	Neutral	23	18,1
	Disagree	5	3,9
	Totally Disagree	3	2,4
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

For me it is important to have a direct on-line connection.



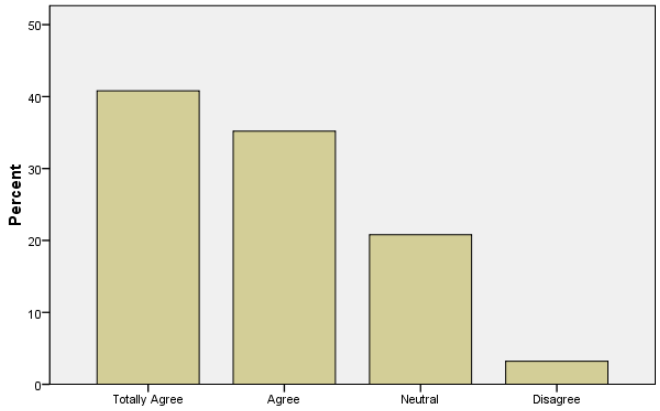
		Frequency	Percent
Valid	Totally Agree	41	32,3
	Agree	61	48,0
	Neutral	22	17,3
	Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

The screen must have a good readableness at all times.



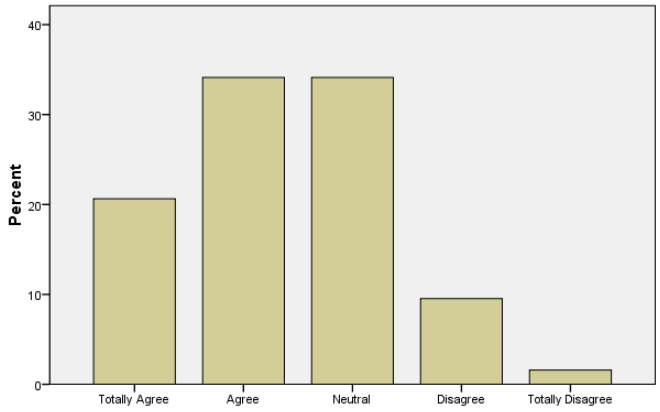
		Frequency	Percent
Valid	Totally Agree	64	50,4
	Agree	54	42,5
	Neutral	7	5,5
	Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

For me the dimension of the screen is important



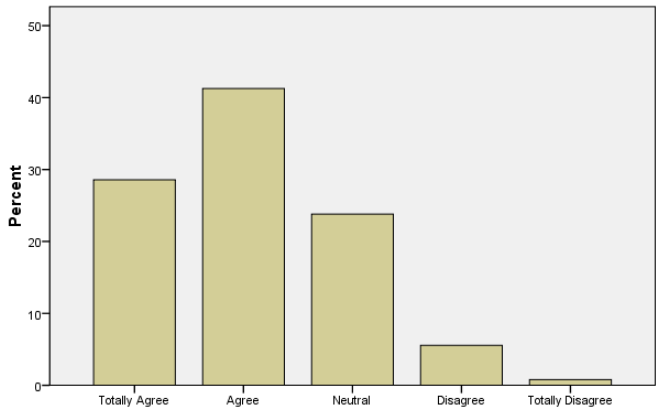
		Frequency	Percent
Valid	Totally Agree	51	40,2
	Agree	44	34,6
	Neutral	26	20,5
	Disagree	4	3,1
	Total	125	98,4
Missing	99	2	1,6
Total		127	100,0

For me it is important to have the possibility of taking the device with me



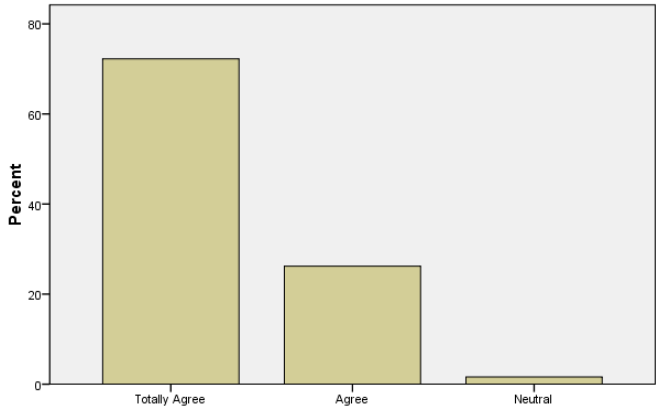
		Frequency	Percent
Valid	Totally Agree	26	20,5
	Agree	43	33,9
	Neutral	43	33,9
	Disagree	12	9,4
	Totally Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

The mobile device must be waterproof.



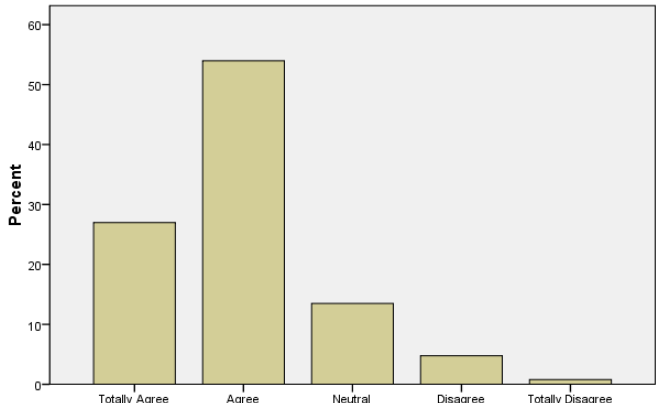
		Frequency	Percent
Valid	Totally Agree	36	28,3
	Agree	52	40,9
	Neutral	30	23,6
	Disagree	7	5,5
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

With IM+ I cooperate with other partners



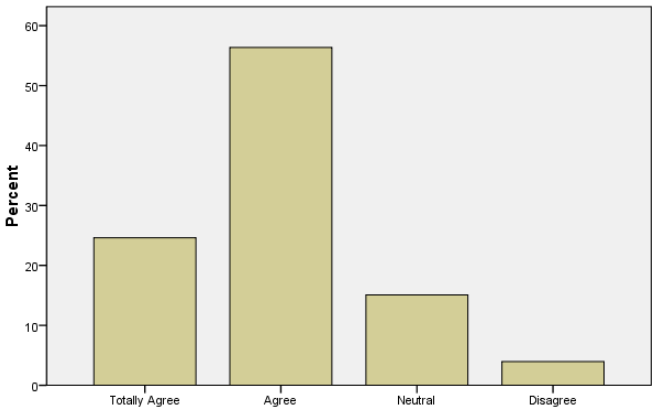
		Frequency	Percent
Valid	Totally Agree	91	71,7
	Agree	33	26,0
	Neutral	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

When carrying out my tasks with IM+ others are dependant on me



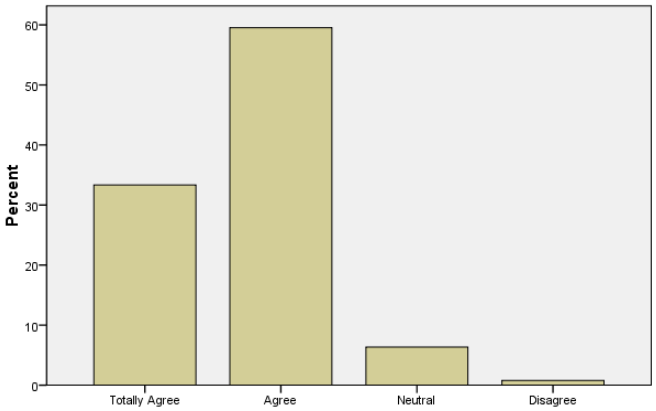
		Frequency	Percent
Valid	Totally Agree	34	26,8
	Agree	68	53,5
	Neutral	17	13,4
	Disagree	6	4,7
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

When carrying out my tasks with IM+ I am dependant on others



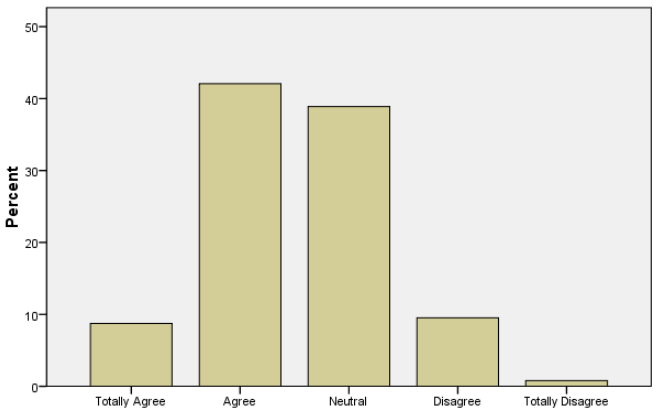
		Frequency	Percent
Valid	Totally Agree	31	24,4
	Agree	71	55,9
	Neutral	19	15,0
	Disagree	5	3,9
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

When carrying out my tasks with IM+ I take the decisions myself



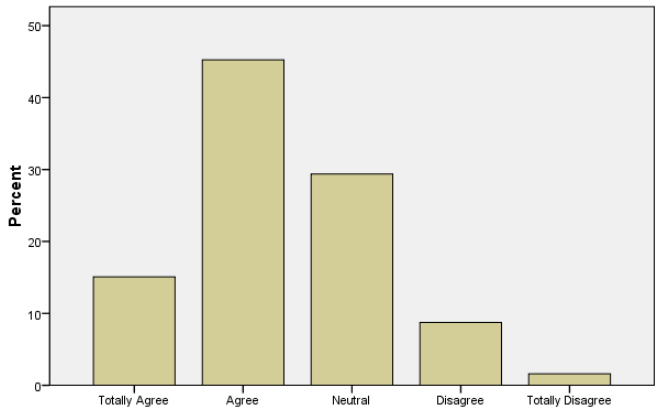
		Frequency	Percent
Valid	Totally Agree	42	33,1
	Agree	75	59,1
	Neutral	8	6,3
	Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

When carrying out my tasks with IM+ I am managed by others



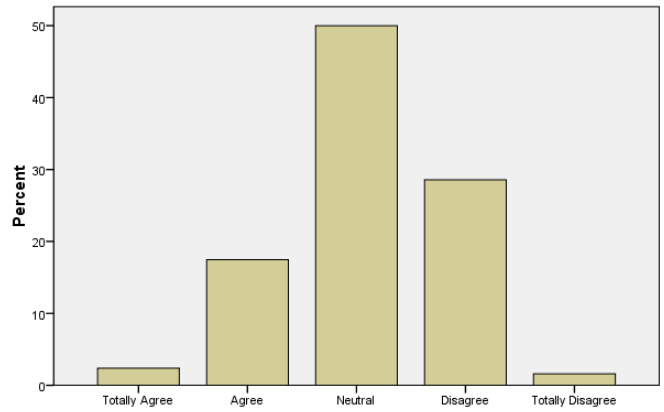
		Frequency	Percent
Valid	Totally Agree	11	8,7
	Agree	53	41,7
	Neutral	49	38,6
	Disagree	12	9,4
	Totally Disagree	1	,8
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

Without up-to-date information I can not do my work properly



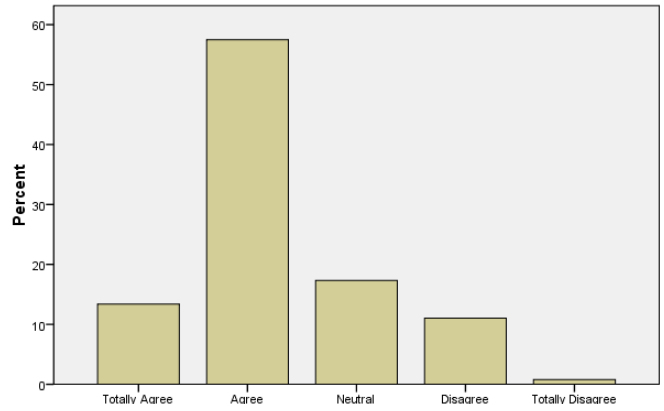
		Frequency	Percent
Valid	Totally Agree	19	15,0
	Agree	57	44,9
	Neutral	37	29,1
	Disagree	11	8,7
	Totally Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

I am missing information to do my IM+ tasks properly



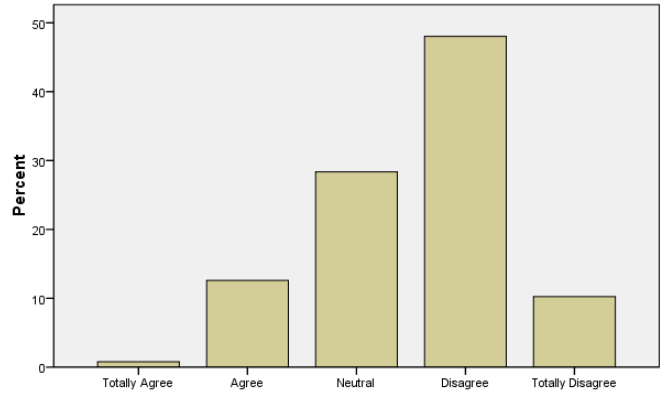
		Frequency	Percent
Valid	Totally Agree	3	2,4
	Agree	22	17,3
	Neutral	63	49,6
	Disagree	36	28,3
	Totally Disagree	2	1,6
	Total	126	99,2
Missing	99	1	,8
Total		127	100,0

I always know exactly where to find my resources



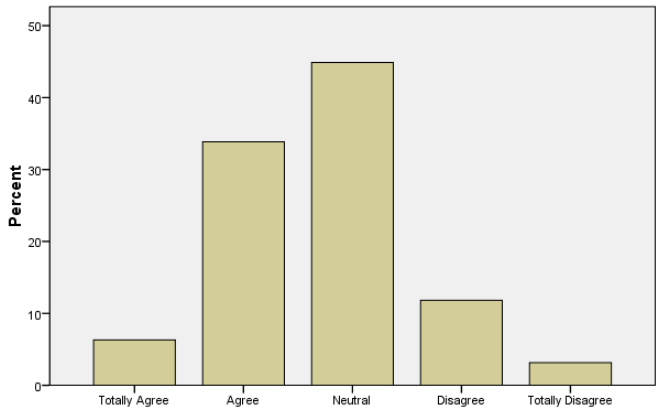
		Frequency	Percent
Valid	Totally Agree	17	13,4
	Agree	73	57,5
	Neutral	22	17,3
	Disagree	14	11,0
	Totally Disagree	1	,8
	Total	127	100,0

By using LS as information service I have a better insight in the location of my resources



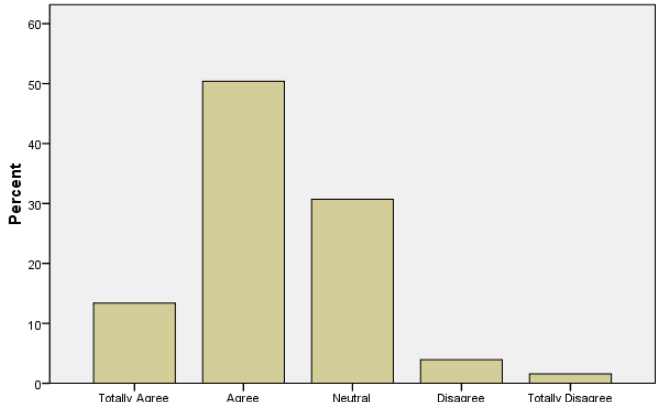
		Frequency	Percent
Valid	Totally Agree	1	,8
	Agree	16	12,6
	Neutral	36	28,3
	Disagree	61	48,0
	Totally Disagree	13	10,2
	Total	127	100,0

By using LS as information service I can be better deployed



		Frequency	Percent
Valid	Totally Agree	8	6,3
	Agree	43	33,9
	Neutral	57	44,9
	Disagree	15	11,8
	Totally Disagree	4	3,1
	Total	127	100,0

I always know exactly the location of my partners



		Frequency	Percent
Valid	Totally Agree	17	13,4
	Agree	64	50,4
	Neutral	39	30,7
	Disagree	5	3,9
	Totally Disagree	2	1,6
	Total	127	100,0

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